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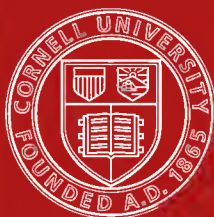
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# National Industrial Conference Board

15 BEACON STREET, BOSTON, MASS.

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THE National Industrial Conference Board is a co-operative body composed of representatives of national and state industrial associations, and closely allied engineering societies of a national character, and is organized to provide a clearing house of information, a forum for constructive discussion, and machinery for co-operative action on matters that vitally affect the industrial development of the nation.

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HOURS OF WORK AS RELATED  
TO OUTPUT AND HEALTH  
OF WORKERS

*Metal Manufacturing Industries*

RESEARCH REPORT NUMBER 18  
JULY, 1919

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## Foreword

**T**HIS report is the fifth of a series issued by the National Industrial Conference Board as the result of an investigation into the relationship between different hours-of-work schedules, efficiency of production and health of workers. The basis of this study is the experience of employers in the principal industries of the country.

In the reports previously issued — those on the cotton manufacturing, wool manufacturing, silk manufacturing and the boot and shoe industries — the information collected by questionnaire was supplemented by extensive field investigation and study of statistical records. In the case of the metal trades, for reasons set forth in this report, it was found impracticable to assemble extensive statistical data. It should be understood, therefore, that the present report is primarily based on the collective judgment of manufacturers as contained in replies to the questionnaire. These replies were checked by extensive correspondence, and by some field investigation, and the Board is satisfied that the conclusions drawn are trustworthy.

Conclusions as to the proper length of the workday must take into account not only the effect on output and on health, but also the need of the worker for a reasonable period of leisure for recreation, home life, and self-development.

The problem varies so widely in different industries — because of differences in type of worker, in character of product, in management, and particularly in the extent to which automatic machine processes influence results — that the experience of any one industry must not be taken as representative of industry in general.



# Hours of Work as Related to Output and Health of Workers

## METAL MANUFACTURING INDUSTRIES

### INTRODUCTION

This study of the hours-of-work problem in the metal manufacturing industries was conducted with the same general purpose as the Board's earlier studies of the cotton,<sup>1</sup> boot and shoe,<sup>2</sup> wool,<sup>3</sup> and silk<sup>4</sup> manufacturing industries, viz., to assemble the results of actual experience with reductions in hours of work as reflected in output and in the health of workers.

The present report includes the metal trades proper, foundries, automobile, hardware, electrical equipment, and some miscellaneous establishments.

Because of the large number of metal trades establishments which have in recent years made substantial reductions in work schedules, interest now centers in experience with a 50-hour and a 48-hour week.

Analysis of the evidence submitted by establishments working on these schedules indicates that a universal reduction to a 50-hour week in the metal manufacturing industries would involve a loss in output; nevertheless, the number of establishments maintaining production with such a schedule is sufficiently large to indicate that a 50-hour week could be rather generally introduced without seriously curtailing production.

In the case of a 48-hour week a smaller percentage of establishments reported production as maintained, and several of these, because of unusual size, exacting nature of the work, or other reasons, were not representa-

<sup>1</sup> Research Report No. 4, "Hours of Work as Related to Output and Health of Workers — Cotton Manufacturing." March, 1918.

<sup>2</sup> Research Report No. 7, "Hours of Work as Related to Output and Health of Workers — Boot and Shoe Industry." June, 1918.

<sup>3</sup> Research Report No. 12, "Hours of Work as Related to Output and Health of Workers — Wool Manufacturing." December, 1918.

<sup>4</sup> Research Report No. 16, "Hours of Work as Related to Output and Health of Workers — Silk Manufacturing." March, 1919.

tive organizations. Notwithstanding the fact that under certain conditions reductions to such a week have proved satisfactory from a production standpoint, the weight of the evidence leaves little ground to doubt that a general reduction to a 48-hour week at the present time would mean a serious loss in production.

Ability to maintain production when work-hours are reduced to 50 or 48 per week is largely influenced by the amount of handwork. Where production is practically dependent on highly automatic machinery such schedules cannot be expected to maintain maximum output.

Output and health are, of course, not the only tests of the justification of any hours-of-work schedule. The broad social aspects of the problem as to the proper work schedule are of great importance. The social factors may, however, be more intelligently considered in the light of reliable information concerning the relation of health and output to hours of work. The purpose of this and the previous reports of the series is to determine the facts on these fundamental points, leaving the social features for later discussion.

## STATISTICAL BASIS OF THIS REPORT

In the course of the investigation two questionnaires were sent out, one in the latter part of 1917, the second in March, 1919, primarily intended to secure data regarding changes in hours made during the intervening period. Replies were received from 1,252 establishments employing 753,561 workers. Of these, 413 establishments,<sup>1</sup> employing 358,336 workers had reduced hours, and furnished data as to the effects of such reductions.<sup>2</sup>

A classification, by states, of establishments furnishing definite replies as to the effects of reductions in hours follows:

<sup>1</sup> Throughout this report the word "establishment" is used to designate a corporation, partnership, or individual submitting a schedule. When a single management operating several plants returned a consolidated schedule, this was necessarily treated as one establishment.

Owing to the fact that during the interval between the time of filling out the first and second questionnaires some establishments replying to the first inquiry had again reduced hours, there is some duplication in the number of establishments in these figures; this is indicated in connection with the summary comparisons given in the appendix of this report. Obviously, however, the experience of one establishment with two successive reductions in hours of work is quite as valuable as that of two separate establishments with a single reduction.

<sup>2</sup> This total includes factory employees only.

TABLE I: GEOGRAPHICAL DISTRIBUTION OF ESTABLISHMENTS AND EMPLOYEES COVERED BY THE INVESTIGATION, 1917 AND 1919

(National Industrial Conference Board)

State	1917 Inquiry			1919 Inquiry		
	Establishments	Employees		Establishments	Employees	
		Number	Per cent		Number	Per cent
<i>Total</i>	<u>281</u>	<u>256,775</u>	<u>100.0</u>	<u>132</u>	<u>101,561</u>	<u>100.0</u>
California	6	1,499	0.6	1	117	0.1
Connecticut	34	16,432	6.4	13	19,276	19.0
Illinois . . .	25	28,880	11.2	13	9,614	9.5
Indiana . . .	9	5,497	2.1	11	5,486	5.4
Maine . . .	3	1,669	0.6			
Massachusetts	28	23,428	9.1	15	5,821	5.7
Michigan . . .	29	79,267	30.8	9	9,531	9.4
Missouri . . .	4	1,252	0.5	2	737	0.7
New Jersey . . .	20	9,597	3.8	7	3,076	3.0
New York . . . .	34	15,528	6.1	17	6,145	6.1
Ohio . . . .	42	20,210	7.9	16	7,443	7.3
Pennsylvania	26	39,041	15.2	10	18,789	18.5
Rhode Island . . .	3	6,379	2.5	4	7,025	6.9
West Virginia . . .	2	536	0.2			
Wisconsin . . . .	6	5,085	2.0	9	6,754	6.7
All others . . . .	10	2,475	1.0	5	1,747	1.7

The geographical distribution of the establishments covered by this investigation is fairly representative of the several metal working regions of the United States.

The results of reductions in hours here presented are based chiefly on the judgment of manufacturers as expressed in their replies to questionnaires. These judgments, which were in many cases verified by extensive correspondence or by field work, were in turn based on plant records or personal observation of manufacturers, though such information was not always sufficiently definite to permit precise measurements.

Owing to the great variety of work in the metal working industry, the frequent changes in raw materials and in other factors which introduce important differences in tasks ordinarily regarded as substantially the same, it was found impracticable to secure detailed statistical comparisons of output analagous to those presented in previous reports in this series. In many cases such statistical results for the metal trades would be applicable only to small groups of workers.

In view of the large number of establishments covered by the metal trades study, however, and the definite

character of many of the statements made, showing on their face that they were the careful expression of mature judgment, sound conclusions may be drawn from the collective experience of manufacturers thus secured. This can be done with the more confidence in view of the fact that extensive field studies in the other industries thus far investigated substantially corroborated the evidence obtained by the questionnaires. Moreover, this was true of the limited amount of field work done in the metal trades. Indeed, where conditions present such a wide range of variation as often occurs in the metal trades, careful judgment of a large number of manufacturers as to the effect of changes in hours-of-work schedules on output may be a safer criterion than statistical comparisons for particular occupations or for particular groups of workers.

### GENERAL FEATURES OF METAL MANUFACTURING

*Machine Time Feature of the Work.* Metal working, on the whole, unlike the textile industries previously reported on, cannot be classed as dominated by either machine or hand work. In many metal manufacturing establishments skilled handwork controls production; in others a large part of the work consists in tending automatic machines in consequence of which the production rate of the plant is governed largely by machine operations rather than by the efforts of the operatives. In general, however, a large amount of skilled handwork, either with or without machines, is involved in the several branches of the industry.

*Wages.* According to data thus far assembled in a study by the Board of changes in wages in wartime, average hourly earnings of both male and female workers in the metal trades were higher in 1914 than were those in any other of eight major industries included in that investigation.<sup>1</sup>

*Low Percentage of Women and Minors.* The number of women and children employed in the industry is distinctly lower than in the textile industries, and lower than the average for manufacturing in general.<sup>2</sup> Com-

<sup>1</sup> These were: Metal Trades, Cotton, Wool, Silk, Boots and Shoes, Paper, Chemicals, Rubber.

<sup>2</sup> The U. S. Census of Manufactures of 1914 showed percentages of women and minors under sixteen years of age in certain occupations as follows: cotton manufacturing, women 38.2, minors 8.4; wool manufacturing, women 41.5, minors 3.6; silk manufacturing, women 54.3, minors 7.2.



pilations based on data for 281 establishments included in this investigation showed the following distribution:

<i>Total</i> . . . . .	<u>256,775</u>	<u>100.0%</u>
Men . . . . .	239,341	93.2
Women . . . . .	16,325	6.4
Boys . . . . .	844	0.3
Girls . . . . .	265	0.1

*Size of Establishments.* No other industry is characterized by so wide a range in size of plants. The largest establishment covered by the report employed more than thirty-four thousand workers, while the smallest employed less than fifty. The capital invested in metal manufacturing industries is likewise subject to great variations. These variations are sometimes a result of the great variety in products, but more frequently they are the reflection of different degrees of development of particular enterprises. The machinery and general equipment of necessity range from the simplest to the most complicated. All of these considerations obviously have a bearing on the hours-of-work problem.

## PRESENT HOURS IN THE METAL MANUFACTURING INDUSTRIES

With respect to present hours of work, a large proportion of metal manufacturing establishments fall in the 48, 50, 54, and 55 hour groups.

Of the 279 establishments replying to the second questionnaire, over one-third were on schedules of 48 or 50 hours per week. About 35 per cent were working on schedules of 54 or 55 hours per week. Less than 10 per cent were on schedules above 55 hours per week.

Nearly two-thirds of the workers in establishments replying to the second questionnaire were employed in plants operating on schedules of 50 hours per week or less. For the industry as a whole this ratio is doubtless too high, since many establishments, not having reduced hours within recent years, did not reply to the questionnaire. It is clear, however, that a considerable proportion of the industry is working on schedules close to

50 hours per week.<sup>1</sup> A detailed summary is given in Table 2:

TABLE 2: ESTABLISHMENTS AND EMPLOYEES COVERED BY REPLIES TO 1919 QUESTIONNAIRE, GROUPED ACCORDING TO NOMINAL HOURS OF WORK PER WEEK

(National Industrial Conference Board)

Hours per Week	Establishments		Employees	
	Number	Per cent	Number	Per cent
Total	279	100.0	147,795	100.0
44	8	2.9	6,968	4.7
44½	2	0.7	2,842	1.9
45	18	6.5	20,239	13.7
47	1	0.4	95	0.1
47½	3	1.1	1,009	0.7
48	45	16.1	37,729	25.5
49 <sup>b</sup>	2	0.7	454	0.3
49½	7	2.5	1,395	1.0
50	52	18.6	27,537	18.6
51 <sup>c</sup>	2	0.7	950	0.6
52	4	1.4	11,273	7.6
52½	10	3.6	3,059	2.1
53	2	0.7	275	0.2
54	53	19.0	10,989	7.4
55	45	16.1	16,389	11.1
56 <sup>d</sup>	3	1.1	1,007	0.7
57 <sup>e</sup>	2	0.7	913	0.6
57½	4	1.4	1,196	0.8
58	1	0.4	65	0.1
59	9	3.2	2,090	1.4
59½	1	0.4	20	0.0
60	5	1.8	1,301	0.9

<sup>a</sup> In the case of some establishments running less than 48 hours per week, the reduction was intended to be temporary; a few establishments which had for extraordinary reasons reduced to less than 44 hours per week are omitted.

<sup>b</sup> One of these establishments was on a 48¾ hour schedule.

<sup>c</sup> One of these establishments was on a 51¾ hour schedule.

<sup>d</sup> One of these establishments was on a 56¾ hour schedule.

<sup>e</sup> One of these establishments was on a 57¾ hour schedule.

<sup>1</sup>The National Metal Trades Association under date of May 24, 1919, stated the weekly work-schedules of 498 establishments replying to a questionnaire as of May 15, 1919, as follows:

50 hours	89	18%
51 hours	10	2%
52 hours	53	11%
53 hours	12	2%
54 hours	105	21%
55 hours	149	30%
56 hours	3	7/10%
57 hours	1	2/10%
58 hours	2	4/10%
59 hours	23	4 7/10%
Working less than 50 hours per week	447	90%
	51	10%
Total number replying	498	100%

## SATURDAY HALF-HOLIDAY

The Saturday half-holiday is quite generally observed in the metal manufacturing industries. Thus, of 600 establishments reporting on this point in the 1917 questionnaire, 455 did not work Saturday afternoon. Likewise, of 265 reporting in the 1919 questionnaire, 175 closed at about noon on Saturday, while 24 others worked only five days per week.

A considerable number of the establishments which reduced hours effected such reductions by inaugurating a Saturday half-holiday. While a majority failed to maintain production, there is little evidence that such block reductions, as distinguished from a distribution of the reduction throughout the week, had any significant influence on output. Of 65 such establishments replying to the 1917 questionnaire, 26 maintained, two increased, and 39 lost production, while of 23 such establishments replying to the 1919 questionnaire, three maintained, one increased, and 19 lost output.

### PERCENTAGE OF OPEN SHOP ESTABLISHMENTS

The replies to the second questionnaire indicate that approximately 93 per cent of these establishments were open shops. Following is a summary for 268 establishments reporting on this point:

	Establish- ments	Per cent	Employees	Per cent
Totals	268	100.0	117,984	100.0
Open shop . . . . .	248	92.5	115,055	97.5
Closed union . . . . .	12	4.5	1,812	1.5
Closed non-union . . . . .	8	3.0	1,117	1.0

As the term "open shop" is sometimes loosely used, it is possible that in this summary there are included as open shops a few establishments which are in reality closed non-union shops. There can be little doubt, however, that a great majority of the metal trades establishments of the country are at present conducted on the open shop basis.

## HOURS AND OUTPUT

As stated on page 2 the data for this report as to the effect of reductions in work-hours on output were chiefly obtained through two questionnaires, one sent out the latter part of 1917 in the midst of the war, the other in March, 1919, in the midst of the readjustment period. Since conditions in the two periods differed to an extent which might affect the efficiency of production, it was deemed advisable to present the results of the two studies separately before drawing conclusions.

### RESULTS OF 1917 INQUIRY

Altogether 281 establishments which had reduced hours submitted the results of this reduction on output in reply to the 1917 schedule.<sup>1</sup> These establishments had 256,775 employees in 1917. There is therefore a broad basis of experience for purposes of analysis. A summary follows:

TABLE 3: SUMMARY OF CHANGES IN OUTPUT ACCOMPANYING REDUCTIONS IN HOURS OF WORK, BY HOUR GROUPS — 1917 QUESTIONNAIRE  
(National Industrial Conference Board)

	Production Maintained or Increased			Production Decreased		
	Previous Hours	Establishments	Employees	Previous Hours	Establishments	Employees
<u>Reduced to 45 Hours</u>	50	1	278			
	60	1 2	69 1,543	60	1	80
		1	2,509			
<u>Reduced to 48 Hours</u>	55	2 <sup>a</sup>	644	55	6	3,296
		3	34,921			
	54	4	4,493	54	10	3,702
	53	1	325	53	1	13
	52½	1	385	52½	2	1,021
	50	3	1,777	50	2	944
				49½	1	149
<u>Reduced to 49½ Hours</u>	55	1	148			
	55	1	488	55	3	1,328
	52	1	186	54	1	100

<sup>a</sup> One establishment with 44 workers reduced to a 47½-hour week.

Italics denote increases.

<sup>1</sup> Six establishments which had reduced hours below 44 per week, evidently because of some extraordinary conditions, are excluded from this compilation. In all but one of these cases output was reduced.

TABLE 3: SUMMARY OF CHANGES IN OUTPUT ACCOMPANYING REDUCTIONS IN HOURS OF WORK, BY HOUR GROUPS — 1917 QUESTIONNAIRE — *continued*  
(National Industrial Conference Board)

	Production Maintained or Increased			Production Decreased		
	Previous Hours	Establishments	Employees	Previous Hours	Establishments	Employees
<i>Reduced to 50 Hours</i>	60	1	320	60	2	66
	59	2	1,342	57 $\frac{3}{4}$	1	32
	57	1	10,030	55	13	8,998
	56 $\frac{1}{4}$	1	172	54	13	8,210
		2	258			
	55	12	14,433	53 $\frac{3}{4}$	1	569
<i>Reduced to 51 or 51<math>\frac{1}{2}</math> Hours</i>		2	3,166			
	54	7	2,802	53	1	196
	53	1	112	52 $\frac{1}{2}$	1	1,868
	52 $\frac{1}{2}$	2	3,832	52	1	13,075
	52	1	306	51 $\frac{3}{4}$	1	12
	55 $\frac{1}{2}$	1	126			
<i>Reduced to 52 or 52<math>\frac{1}{2}</math> Hours</i>	54	2	974	54	3	1,453
	57	1	20	60	1	140
	56 $\frac{1}{2}$	1	36	58	1	225
<i>Reduced to 53 or 53<math>\frac{1}{2}</math> Hours</i>		3	1,970			
	55	11	5,850	57 $\frac{1}{2}$	1	87
	54	2	24,534	55	11	5,350
	53	1	1,032	54	2	4,132
		1	71			
<i>Reduced to 54 Hours</i>	59	2	403	57 $\frac{1}{2}$	1	153
	57 $\frac{1}{2}$	1	500			
	54	1	210			
<i>Reduced to 55 Hours</i>	60	13	17,410	61	1	76
		2	825	60	21	6,222
	59	1	237	59	2	1,107
	56	2	232	58 $\frac{1}{2}$	1	361
	55	1	4,306	58	3	2,310
				57	2	943
<i>Reduced to 56<math>\frac{1}{2}</math> Hours</i>				56	2	1,871
				55	1	1,307
	61	1	363			
	60	8	3,234	60	12	10,070
		2	10,594	59	15	12,210
<i>Reduced to 57 Hours</i>	59	8	2,666			
	58	4	1,859	58	6	560
		1	130			
	57 $\frac{1}{2}$	3	356	57 $\frac{1}{2}$	2	830
<i>Reduced to 58 Hours</i>						
<i>Reduced to 59 Hours</i>				60	1	231
	60	1	100			
	60	1	118			
	60	1	500	60	1	250

Italics denote increases.

## SUMMARY FOR PRINCIPAL HOUR GROUPS

	Establishments			Employees		
	Increased	Main- tained	Decreased	Increased	Main- tained	Decreased
Reduced to 48 hours	5	13	23	37,499	9,167	9,238
Reduced to 50 hours	4	28	34	3,424	33,349	33,026
Reduced to 52-52½ hours . . . . .	4	15	16	2,006	31,436	9,934
Reduced to 54 hours	2	17	33	825	22,185	14,197
Reduced to 55 hours	3	24	35	10,724	8,478	23,670

The summary for the principal hour groups shows that of 41 establishments which reduced to a 48-hour week, five reported an increase in production, 13 that production was maintained, while 23 reported a loss. The group of establishments reporting an increase in production had much more than two-thirds of the total number of workers in the 48-hour group. One of the establishments increasing production was exceptionally large, which gives a disproportionate weight to the "increased" group from the standpoint of numbers employed. In this large establishment, moreover, various changes were made at the time the 48-hour week was adopted and the increase in output cannot be attributed to the reduction in hours alone.<sup>1</sup> The management, however, expressed its conviction that the shorter day was conducive to better output. It should be noted that 16 establishments, none of which were of exceptional size, reported either an increased or a maintained output under such a schedule. Furthermore, in four establishments reporting a decrease in output the loss was comparatively small.

Of 66 establishments which reduced to a 50-hour week, four reported production as increased, 28 as maintained, and 34 as reduced. The groups maintaining or increasing production represented approximately half the number of establishments in this group, and these two sub-groups together had rather more than half the total number of workers included in the 50-hour group. Moreover, in three of the establishments reporting production as decreased, pieceworkers maintained their output, while in five others the loss was comparatively small.

<sup>1</sup> See p. 30.

For the 52-hour and 52½-hour groups experience was more evenly divided—four establishments reporting production as increased, 15 that it was maintained and 16 that it was reduced. The group maintaining production had a large majority of the total number of workers included in these hour groups.

In the case of the 54-hour group, the number of establishments maintaining or increasing production was only a little over half as large as that of establishments reporting a decrease. These two sub-groups, however, together had much more than a majority of the total number of workers in the 54-hour group. Of 62 establishments in the 55-hour group, three increased production and 24 maintained; these two sub-groups had over 40% of the total number of workers in the 55-hour group. The relatively large number of establishments which failed to maintain production on such schedules appears surprising in view of the substantial number of concerns which reported production as increased or maintained on much shorter hours. This matter is referred to later. (See page 28.)

Results for the other hour groups presented in the table included too small a number of establishments to warrant extended analysis.

## RESULTS OF THE 1919 INQUIRY

Replies to the questionnaire sent out in 1919 were filed by 132 establishments which had reduced hours following reductions reported in their replies to the 1917 questionnaire, or by establishments which were not included in that inquiry. These establishments together had 101,561 workers and, in general, represented the same branches of the industry as those replying to the earlier questionnaire, except that only a few automobile plants are included. A summary of output results similar to that already given for the 1917 inquiry is given in Table 4:

TABLE 4: SUMMARY OF CHANGES IN OUTPUT ACCOMPANYING REDUCTIONS IN HOURS OF WORK, BY HOUR GROUPS,—1919 QUESTIONNAIRE

(National Industrial Conference Board)

	Production Maintained or Increased			Production Decreased		
	Previous Hours	Establishments	Employees	Previous Hours	Establishments	Employees
<i>Reduced to 44 or 44½ Hours</i>	.....	.....	.....	59	2	691
				55	3	4,468
				52½	3	702
				48	1	538
<i>Reduced to 45 Hours</i>				60	2	446
				55¼	1	161
				55	6	15,242
				54	1	209
<i>Reduced to 47 or 47½ Hours</i>				50	2	1,320
	52½	1	378	52½	2	678
				60	2	1,225
				59	1	42
<i>Reduced to 48 Hours</i>				56	1	252
	55	1	1,985	55	6	10,731
	54	2	232	54	11	8,326
				53¾	1	170
	52½	1	360	52½	7	6,510
	52	1	3,241	51	3	988
<i>Reduced to 49½ Hours</i>	50	1	415	50	2	1,119
	55	1	430	55	1	210
	54½	1	185	52½	1	60
				52	1	300
<i>Reduced to 50 Hours</i>	60	1	60	60	1	78
	59	1	901	59	5	2,966
	57	1	19	55	14	10,404
			669			
	55	7	2,005	54	4	1,102
<i>Reduced to 51 Hours</i>	52½	1	250	52½	1	100
	54	1	800	.....	.....	.....
<i>Reduced to 52 or 52½ Hours</i>	55	3	1,680	55	1	152
	54	1	537	54	1	10,400
<i>Reduced to 53 Hours</i>				58	1	32
<i>Reduced to 54 Hours</i>				60	2	295
	59	2	2,060	59	1	26
	58	1	260	58	1	1,094
				57	1	105
				55	1	223
<i>Reduced to 55 Hours</i>	60	2	159	60	1	15
				59	4	876
				57½	1	2,614
<i>Reduced to 57½ Hours</i>	60	1	65	.....	.....	.....

Italics denote increases.



## SUMMARY FOR PRINCIPAL HOUR GROUPS

	Establishments			Employees		
	Increased	Main- tained	Decreased	Increased	Main- tained	Decreased
Reduced to 48 hours	1	5	34	3,241	2,992	29,363
Reduced to 50 hours	2	10	25	1,570	2,334	14,650
Reduced to 52-52½ hours		4	2		2,217	10,552
Reduced to 54 hours		3	6		2,320	1,743
Reduced to 55 hours		2	6		159	3,505

The results of the 1919 inquiry are considerably less favorable to the practicability of a 48-hour or a 50-hour week than are those obtained as a result of the 1917 inquiry. So far as the 48-hour group is concerned, the number of establishments maintaining or increasing production on such a schedule was small, likewise the total number of workers included in them. In the case of the 50-hour schedule, the number of establishments maintaining or increasing production was 12, as against 25 reporting a decrease, while they had only about one-fourth the number of workers included in the 50-hour group. The basis of experience is therefore much more limited than that covered by Table 3. In this connection it should be pointed out that practically all of the experience obtained through the 1919 questionnaire occurred under highly abnormal conditions. During the greater part of 1918, when approximately one-third of the reductions covered by this questionnaire took place, wages were exceptionally high and the demand for labor was extraordinary. On the other hand, after the signing of the armistice, business in many branches of the metal trades was more or less demoralized and frequently there was a shortage of orders, so that workers had less incentive to maintain maximum efficiency, while the mere reaction from the extraordinary stress of war in itself often had a tendency in the same direction. For all these reasons, the evidence gathered by the 1917 questionnaire is a safer criterion of the practicability of a shorter hours-of-work schedule than is that obtained through the 1919 questionnaire.

A few establishments included in this summary were operating on a two-shift system, but the results with respect to the efficiency of a given hours-of-work schedule were not significantly different from those for plants operating on a single shift basis.

Before drawing final conclusions, attention should briefly be called to a few special factors in the problem and to further evidence gathered by correspondence and field inquiry.

## FACTORS BEARING ON EFFICIENCY

### SIZE OF ESTABLISHMENT

In general, the size of the establishment did not appear to exert a controlling influence on changes in production when hours of work were shortened. An examination of the appendix tables shows a wide range in the number of employees in the group of establishments maintaining production as well as in the group reporting a decrease, and this holds true of each of the principal hourly schedules for which replies were received.

The same variety of experience was found in the case of several exceptionally large establishments, each employing over 10,000 workers. One of these reported an increase in production in reducing hours from 54 to 48 per week. Another reported an increase in production when hours were reduced from 59 to 55, one that output was maintained when hours were reduced from 57 to 50, and another that it was maintained when hours were reduced from 54 to 52. The other three reported a loss in output, but in one of these (which reduced from 52 to 50 hours per week) the pieceworkers maintained their production, and the decrease in the output of dayworkers was not in proportion to the reduction in hours. In another of these three establishments, moreover, the change in hours was from 55 to 45 per week, an unusually large reduction. In the third large establishment reporting a decrease in output the reduction in hours was from 54 to 52 per week.

While for this group of exceptionally large establishments experience with the shorter week was perhaps somewhat more favorable than the average experience for all establishments included in the appendix tables, the difference was not marked and cannot safely be attributed to the factor of size. Comparing the experience of establishments with from say 200 to 1,000 workers each there is little evidence to show that the size of the establishment was a controlling influence.

## INFLUENCE OF MANAGEMENT

Undoubtedly a factor in the results in some cases was the improvement in methods of management which frequently are introduced when hours of work are shortened. Obviously, if any major change in management or in machinery is introduced concurrently with reductions in hours of work it becomes exceedingly difficult, if not impossible, to determine how far any accompanying changes in production were due to the change in hours alone. A special effort was made to guard against this difficulty, however, as will be seen from the following excerpt from the questionnaire:

What change, if any, was made at or about the time of reduction in hours:

- (a) In piece rates?
- (b) In hourly rates of time-workers?
- (c) In method of wage payment?
- (d) In type or speed of machinery?
- (e) In number of machines tended by one operative?
- (f) In "standard" or required production?
- (g) In regulations affecting punctual or full-time attendance?
- (h) Other important changes?

What has been the effect of such reduction in hours on :

- (a) Total output per employee, percentage change?\*
- (b) Labor cost per unit of product, percentage change?\*
- (c) Amount of lost time, percentage change?\*
- (d) Tardiness?
- (e) General health of employees?
- (f) General attitude of employees?
- (g) Frequency of accidents?
- (h) Quality of work?
- (i) Other important changes?

For Piecework	For Daywork

Approximately what proportion of your employees are on a piece-rate basis?

If your wage system includes a bonus or premium feature, give details.

\*Please state whether change was an increase or a decrease.

In a few cases where radical changes were made in type of machinery or in other major respects the evidence was excluded from the compilations. In most cases, however, the changes were of a character which did not discredit the evidence.

In this connection the following statement by the president of a steel tube company which reduced from 50 to 45 hours per week may be cited:

We introduced closer supervision and more foremen; we pushed them harder. Production has been maintained. Men can be pushed harder eight hours; after that they show the strain and lag. We would not consider the return to a ten-hour day.

#### INFLUENCE OF AUTOMATIC MACHINERY

The amount of handwork as contrasted with automatic machine work exerts an important influence on output. In establishments where a very high percentage of the work is performed by automatic machinery the evidence indicates that maximum production cannot, in general, be had on a schedule as low as 50 hours per week. Doubtless a part of the differences in results reported by establishments operating on the same schedule of hours is a reflection of the degree of machine domination in those plants. This is in substantial accord with results obtained in the four other industries studied by the Board. Thus in both the wool and northern cotton manufacturing industries, where machinery largely dominates production, the adoption of a 54-hour week generally resulted in decreased production. In the boot and shoe and silk manufacturing industries, on the other hand, where handwork plays a much more important part, the evidence indicated that maximum production could be maintained on a schedule substantially less than 54 hours per week, and for silk manufacturing it appeared that the point of maximum production was somewhat nearer 50 hours than 54 hours per week.

In this connection, the following statement by the vice president of a large car building establishment may be cited:

We have gone to 48 hours a week, and no reduction in output was experienced except on machines where the output is governed by the speed of the machine.

The vice president of a sawing machinery company stated:

We consider that the work is proportionate to the hours. We figure that the output of our shop, if we run eight hours per day, is only eight-tenths of what it is when we run ten hours a day. Much of our work is in large pieces and when put in the machine requires only slight supervision on the part

of the operator. He may for two or three hours absolutely do nothing, while his machine is in operation. If our work was laborious, and if it required activity and constant energy, then there is no question but what the last hours in the day would evidence the operator being tired and slower in movement by a decreased output per hour.

## CHARACTER OF WORK

The maintenance of output in general did not appear to depend upon the character of the industry. For instance, as between automobile, hardware, and general machine shops, no significant differences in results when hours were reduced were apparent. Certain types of foundry work present exceptions. For instance, in the process of making some castings the workday cannot be shortened without interfering with production. In this connection it is to be observed that only a comparatively small number of foundry establishments have reduced hours to 50 or 48 per week. Some foundry establishments which reduced to a 54 from a 60-hour week reported output as maintained.

Some evidence was obtained in the course of the investigation to the effect that in the case of work requiring unusual precision or which was for other reasons particularly exacting, there was more opportunity to introduce the eight-hour day successfully than in ordinary metal trades establishments. Thus, the general superintendent of a fine tool manufacturing establishment in which the work required particular skill stated:

We changed from ten to nine hours at our own suggestion and later to eight, without pressure from the outside, as we believe that if a man works conscientiously for a shorter time he can do better work, and that we have a right to expect it. Our records prove the truth of this.

We found that we could get the better quality for which we were looking, and that the men were in better condition and more willing to co-operate with us to get the quality.

In addition we have found that our men were more loyal, even in time of strike which we went through last year, fewer of our men going out than the leaders expected; many of them were ready to come back within a few days.

This establishment, however, further stated:

Certain classes of work can be safely and properly conducted for more hours per day than others.

Another establishment making jigs, tools, dies, gauges, cutters, forming tools and special machinery, all of which call for a high degree of precision in the work, stated:

Our experience has been that the eight-hour day produces a better output together with many other improved conditions.

#### INFLUENCE OF THE PIECE-RATE SYSTEM

It was the experience of a considerable number of establishments in the metal trades, as in other industries thus far studied, that output of pieceworkers was less unfavorably affected when hours were reduced than was the output of dayworkers. In some cases pieceworkers maintained their previous output. The following summary is fairly representative of the experience of a considerable number of concerns in this respect; other statements of similar import will be found in the appendix tables.

An establishment reducing from 54 to 50 hours:

Daywork output decreased about 5%. Piecework maintained.

An establishment reducing from 52 to 49½ hours:

Weekly output of dayworkers decreased 5%; that of pieceworkers maintained.

An establishment reducing from 55 to 48 hours:

Weekly output of dayworkers decreased 20%; that of pieceworkers 6%.

In this connection, the following statement by the president of a large western foundry machine shop is of interest:

Wherever the piece-rate system is used there is no great controversy as to the working hours. In fact, on piecework, men can produce much more in shorter hours than they do under the ordinary day rate of longer hours. There also seems to be greater satisfaction among employees working under piecework as there seems to be greater incentive to work.

In some cases, however, the same percentage reduction in total weekly output of pieceworkers as for dayworkers was reported. In many cases no percentage estimate was submitted.

While the experience above cited is hardly typical of the metal manufacturing industries as a whole, it was reported in a substantial number of cases. In this connection, it is important to note that the proportion

of pieceworkers in the metal trades establishments reporting for this investigation was on the average considerably smaller than in the case of the cotton industry and the boot and shoe industry, as shown in reports already issued on those industries. Thus, for 253 metal manufacturing establishments giving the proportion of their employees paid by the piece-rate system, pieceworkers represented on the average 38% of the total work force. In numerous establishments there were no pieceworkers.

### INFLUENCE OF WAR CONDITIONS

In considering experience with reductions in work-hours since the signing of the armistice, it should be noted that in some instances business was slack and that establishments were compelled to reduce the number of employees. Naturally they were disposed to retain their most efficient workers. As a result the force working on the reduced schedule might have a higher average efficiency than the previous force working under a longer schedule. For example, a structural steel establishment which reduced from 52½ hours to 44 hours per week early in 1919 reported in substance as follows:

A few months ago hours were reduced to 44 per week; at the same time there was a large reduction (for instance, perhaps one-third) in the number of men employees; the less desirable workmen were let go, and only the best retained. As a result of this discriminating process the average production per employee under a 44-hour week equaled the former production under a 52½-hour week. This judgment is based on tonnage production.

A foundry establishment which reduced from 55 to 50 hours per week in January, 1919, also laid considerable stress on the unusual conditions prevailing at that time, and on the factor of selection of employees.

Several other establishments noted a similar selection of workers in the case of recent reductions in hours of work. Nevertheless, comparison of Table 3 and Table 4 shows that, on the whole, experience with a 50-hour schedule since the close of hostilities was rather less favorable than that reported in 1917. It may be that the general uncertainty of conditions during the past few months explains this; or that it was a natural reaction from the high pressure under which much work was conducted during the war.

## SUPPLEMENTAL DATA

As already noted, extensive statistical data covering different hours-of-work schedules were not obtainable. A brief field study for this purpose showed that the difficulties of such comparison, which have been pointed out in previous reports on other industries, were even greater in the case of the metal trades. The great variety of products in the same establishment, and frequent change in the character of the article produced or in precision of work required often rendered exact measurement impossible. Another difficulty arose from the fact that in products made to different specifications, such as special machinery, the character of the work under two different hours-of-work schedules often could not be compared with any degree of accuracy. In view of these and numerous other practical difficulties in the way of securing statistical data which would really be significant, no detailed investigation of book records on a large scale was made.

As an illustration of the difficulty of getting satisfactory statistical data for comparative purposes, the following statement by the general superintendent of a large electric company may be cited:

We are satisfied that most of those employees who are working on piecework or bonus work are turning out as many parts in 48 hours as they formerly did in 50 hours, but since we manufacture over 25,000 different parts and our product is constantly changing, you can readily imagine that to thoroughly check this matter up would be quite difficult, and we have consequently never attempted to do so except in a few cases.

The general manager of another machinery manufacturing corporation stated:

So many conditions enter into our work to alter production, such as machine tools, jigs, special tools, that it is hard to determine the reasons for changes in output.

However, the statements of employers as given in replies to the questionnaire or through correspondence and interviews were so specific as to give a sufficient basis for conclusions as to the result of changes in hours on production. Representative statements made by employers with respect to their experiences are given below.



A large metal trades establishment manufacturing a variety of products, after making special effort to secure comparable data, made the following statement, in substance:

In all 387 lots of parts were considered, these being taken from five different departments of the shop, representing widely different classes of work, as, for example, hand operated machines, assembling and fitting, hand scraping, and general machine work.

In all of these cases the work was performed by the same operator before and after the change in time. Also, in some of the cases, the same operator had carried through more than one lot of parts either before or after the change, and the time of these lots was averaged so as to minimize irregularities. The reduction in hours was 9.1%. The foremen were asked in selecting these cases to be impartial and to select cases regardless of whether they showed greater or less production, unless there was some change of design, or for some special reason the results would be abnormal. All these parts selected or operations analyzed were those which had been done on job or piece work.

Based on the 387 lots referred to, the number of cases considered was 161.

These 161 cases represented the production of 116,842 pieces (or operations) in a week on a 55-hour basis, and a production of 114,228 pieces (or operations) per week, on a 50-hour basis, a net reduction in weekly production of approximately 2.2%. The production per hour on a 55-hour basis was 13.2 pieces or operations, while on a 50-hour basis it was 14.3 pieces or operations, or a gain of 7.9% in production per hour for a 50-hour basis.

Of the total 161 cases 125 showed greater production per hour on a 50-hour basis, 15 showed the same production per hour, while in 21 cases there was less production per hour.

To show the unexpected variations which indicate that such figures as these are not final it may be noted that while in 65 cases of general machine work, the gain was 6% on the hourly basis, with a loss of 3% in production per week, in 25 cases of hand scraping the gain was only  $\frac{1}{2}$ % on the hourly basis, with a loss of  $7\frac{1}{2}$ % in production per week.

It will be noted that this experience relates to piece-work. With respect to daywork the following statement was made:

There is a feeling among our foremen and executives that while we have nothing tangible to show what difference

there may be on daywork the percentage of gain would not be as high as is indicated by the above figures, and while we believe there is a gain per hour for the shorter hour week, it is felt that it would not be as great on the average as the figures here given.

Following is a comparison of results under a 54 and 50-hour schedule furnished by a machinery establishment. The change in hours occurred in 1912. The same general type of machine was constructed in the two periods. The hourly rate of pay was 12 per cent higher under the 50-hour week. The change in hours was made by the introduction of a Saturday half-holiday, and the co-operation of the workers was requested by the management.

	1911	1912
Hours per week . . . . .	54	50
Average number of workers . . . . .	260	245
Number of machines built . . . . .	321	304
Number of employee hours worked for the year . . . . .	730,080	637,000
		<i>Gain</i>
Increase in hourly output per employee . . . . .		8.5%
Increase in weekly output per employee . . . . .		0.5%

This comparison is, of course, distinctly favorable to the 50-hour week. The gain in hourly efficiency a little more than offset the loss in time, so that there was a small increase in total weekly output per employee.

The superintendent of a large middle-western brass company stated:

We are making a definite experiment with one department, the Pattern and Tool Department, in a reduction from 55 hours per week to 50 hours per week, with no reduction in wages per week, and we will say that so far very good results have been obtained. We are getting the same amount of production per week and we are also getting intensity of application and a spirit of co-operation from the men which we asked for, and which was a part of our agreement. The main question we are asking is whether this will continue after the cause which led to the arrangement has been forgotten.

In other departments where we reduced the number of hours per week, because of our production requirements, from 55 hours to 40 and 45 hours per week, we have found that we are getting the same production per day in eight hours that we previously obtained in ten hours from most of the pieceworkers, except in a few cases where it was humanly impossible to do more, largely because of restrictions in the time element inherent in the process.

It should be noted that in this instance the reduction in work-hours was due to a shortage of orders and was intended to distribute the work in hand over a larger number of employees.

The following statement was submitted by a hardware establishment:

This company in the past has operated on the basis of a 10-hour day, from time to time reducing to 9 hours. A number of years ago it established, with some misgiving, a Saturday half-holiday. These changes were voluntary, but each reduction in the number of hours of labor was found to be attended with no reduction in the total production, which seemed to indicate that the energy of our employees was less impaired by the shorter hours, and the result was increased energy during the working period, so that they had the shorter hours and we had the production.

Less favorable experience with reduction in work-hours was reported by other manufacturers. A large western machinery and tool-making establishment stated in part:

Our change from 55 to 52½ hours per week was prompted merely by the feeling on our part that the very great amount of agitation regarding the so-called 8-hour day had created enough comment and attention that it might be only wise for us to plan to end the workday at 5 p.m. We have, however, found it necessary to run a considerable amount of overtime.

On the other hand we believe that for continuous operation the 8-hour shift is correct and proper; also for work requiring skill and concentration, heavy and continuous physical effort, etc. There is, however, certainly a very great difference between work that is largely dependent upon the skill, speed, agility, etc., of the employee, and work that is largely or wholly the product of machines where the speed of the machine determines the output. In the case of automatic machinery there can be no question, and in the case of semi-automatic, and even in the case of machines requiring feeding by hand and some attention, we do not believe that the same production (or more, as is often claimed) can be secured in 9 hours as 10, or in 8 hours as 9 or 10. We also believe that where the work is largely manual much of the increased production reported as taking place upon adoption of the new schedule is not permanent and that even on such work there is a decided tendency to drop back to as low a production per hour as the management will tolerate.

An executive of a large concern making special machinery stated:

A drop was made from 54 to 51 hours a week February 16, 1917. At first the hourly rate of production was slightly increased but later the employees drifted back into their old speed.

The superintendent and chief engineer of a large middle-western milling machine company made the following statement:

When we reduced the hours in 1913 from 55 to 52½ per week there was a corresponding reduction in output for a time. However, as the result of more complete time studies, improved tools and special machinery, our output was later increased to above what we turned out in 55 hours.

We have this month reduced our hours from 52½ to 48 per week, increasing the hourly rate so that the pay will be the same as for 52½ hours. Our output has again been correspondingly reduced but we hope to make some of it up, at least, by further improving our methods.

The secretary of a malleable iron company:

Relative to the effect experienced because of the reduction in the hours per week from 55 to 50, you no doubt realize that an answer to this inquiry is somewhat difficult and complicated for a variety of reasons, some of which are the various schedules under which we have operated within the past year, the character of the work we have been engaged on, the rate of output, etc., but after giving the subject careful thought and discussing it with our superintendent, we have reached the conclusion that under a 50-hour schedule the output per man has averaged a decrease of approximately 10%, while the cost has remained the same as it was previous to the change.

An establishment which reduced from 54 to 50 hours:

Our records show the output decreased in direct proportion with the decrease in the number of hours worked.

An establishment which reduced hours in 1919:

Output, in our business at least, is practically in proportion to the number of hours of work. This has been repeatedly verified.

These various statements give a fair picture of the diversity of experience with and the diversity of attitude among employers toward a 48-hour and a 50-hour week in the metal manufacturing industries.

## CONCLUSIONS AS TO OUTPUT

For a 50-hour and a 48-hour week, in which interest chiefly centers, the evidence presented in the preceding sections may be summarized as follows:

Effect on Output — 48-Hour Group

Output	1917		1919	
	Estab- lishments	Per cent of Total Em- ployees in Group	Estab- lishments	Per cent of Total Em- ployees in Group
<i>Totals</i>	<u>41</u>	<u>100.0%</u>	<u>40</u>	<u>100.0%</u>
Increased . . . . .	5	67.1 <sup>a</sup>	1	9.1
Maintained . . . . .	13	16.4	5	8.4
Decrease, less than proportional . . . . .	4	2.9	8	21.2
Decrease, about proportional . . . . .	10	9.4	14	44.0
Decrease, greater than proportional . . . . .	1	0.5	3	1.5
Decrease, amount not stated . . . . .	8	3.7	9	15.8

Effect on Output — 50-Hour Group

Output	1917		1919	
	Estab- lishments	Per cent of Total Em- ployees in Group	Estab- lishments	Per cent of Total Em- ployees in Group
<i>Totals</i>	<u>66</u>	<u>100.0%</u>	<u>37</u>	<u>100.0%</u>
Increased . . . . .	4	4.9	2	8.5
Maintained . . . . .	28	47.8	10	12.6
Decrease, less than proportional . . . . .	12	28.4	9	42.0
Decrease, about proportional . . . . .	10	9.7	8	11.0
Decrease, greater than proportional . . . . .	2	3.4	1	1.6
Decrease, amount not stated . . . . .	10	5.8	7	24.3

<sup>a</sup>Over 66% of employees in the 48-hour group were in two establishments.

Among the more important facts brought out by this comparison and the preceding discussion are the following:

1. A 50-hour week has proved efficient and practicable in a large number of metal manufacturing establishments.
2. A 48-hour week has proved practicable in a considerable number of establishments.
3. The piece-rate system is more conducive to current efficiency of production than is the day-rate system.

4. There is no clear-cut line below which a reduction in hours brings a practically uniform change in efficiency of production in different establishments.

A majority of establishments changing to a 50-hour schedule lost production, but the number and collective importance of those maintaining output is sufficient to demonstrate that a 50-hour week is a practicable schedule for a large proportion of metal manufacturing establishments. It is true that many manufacturers reported a loss in output even with a 54-hour or a 55-hour schedule. It must be remembered, however, that either because of some disadvantage with respect to location, class of labor, quality of material, nature of the work, faulty management, or other factor, some establishments will fail to maintain maximum output under almost any reduction in hours.

Aside from the actual maintenance of output reported in many cases is the favorable attitude toward a 50-hour schedule by many employers who have introduced it. Thus of 40 manufacturers who had reduced to a 50-hour week and who replied to a query on this point in the 1919 questionnaire, a substantial majority preferred such a schedule, as the following summary shows:

29 preferred a 50-hour week  
3 preferred a 54-hour week  
8 preferred a 55-hour week

Experience with a 48-hour week likewise was favorable in a sufficient number of cases to invest such a schedule with a high degree of interest, and there can be no doubt that a 48-hour schedule will under certain conditions yield maximum efficiency. Several of the establishments which reported favorable experience with such a schedule were, however, either so distinctive as to organization, or other conditions, that their experience cannot be fairly regarded as typical.

Where, as in some plants, the work is largely of an assembling nature and can be standardized to a very high degree, and where workers are driven at high pressure, or where the work calls for unusual precision, the results secured may be quite different from those reasonably obtainable in an ordinary metal trades establishment. But where production is practically dependent on highly automatic machinery, a 48-hour week cannot be expected

to maintain maximum output. Furthermore, conclusive judgment as to the merits of a 48-hour week cannot fairly be reached until the effect of speed on the fatigue and health of workers has been more thoroughly studied.

It may be noted that many employers who had adopted the 48-hour week were satisfied with such a schedule. Thus of 40 establishments employing 25,583 employees working under a 48-hour schedule

20 preferred a 48-hour week  
10 preferred a 50-hour week  
5 preferred a 54-hour week  
4 preferred a 55-hour week  
1 preferred a 60-hour week

Taken in connection with the favorable attitude toward a 50-hour week by employers who had reduced to such a schedule, it appears that of 80 establishments which reduced either to 50 or to 48 hours, only 21 expressed a preference for a week longer than 50 hours. It is true that establishments operating on a 54 or a 55 hour week in nearly all cases expressed a preference for the particular schedule they were using. The experience of these manufacturers who had not reduced hours below 54 per week cannot, however, be given equal weight in reaching conclusions as to the practicability of a shorter week with the experience of employers who had adopted shorter schedules.

Distinction should be made between what can be done and what as a practical matter will be done. Much depends upon the degree of co-operation secured between the management and its workers. If full co-operation to attain the highest reasonable efficiency could be secured there can be little doubt that a 50-hour week could be generally adopted in the metal trades without serious loss of production. Several of the statements given in this report by manufacturers who maintained production when hours were shortened refer to such co-operation. Likewise, the evidence indicates that under such conditions a 48-hour week could be made an economic schedule in a much larger proportion of establishments than is now possible. No single factor could do more to accomplish this result than the recognition by workers of the indisputable principle that their real interest and that their real opportunity for bettering

their condition lies in increasing the efficiency of individual production. But unless both management and workers actively co-operate to this end, there can be little question that the general adoption of a 48-hour week in the metal trades would involve a serious economic loss to the nation.

The evidence clearly indicates that piecework is more conducive to efficiency than is daywork. In this connection, the rather low percentage of pieceworkers in the industry as a whole as compared with the other industries thus far investigated suggests that there is opportunity to increase efficiency by increasing the number of workers on a piece-rate basis. The difficulties in the way of this are often great, especially where quality is the prime consideration. Extension of the piece-rate system, moreover, imposes a greater burden on management. The fact, however, that only about one-third of the workers in the metal trades establishments covered by this report were on a piece-rate basis suggests that there is opportunity for improvement in this direction. It is of course essential to guard against a system of piece-rates which leads to overspeeding.

A striking feature of the evidence brought out by this study, and one which has been noted in the reports on several of the other industries included in the Board's investigation of the hours-of-work problem, is that there is no clear-cut line below which a reduction in hours brings a practically uniform change in results. Thus, despite the fact that a substantial number of establishments maintained production on a 48-hour week and a rather large number on a 50-hour week, a majority of establishments reducing only to 54 or 55 hours per week nevertheless reported that production was decreased. This diversity of experience is characteristic of industries where production is not virtually controlled by machinery and must constantly be kept in mind. It means that reductions in work-hours are only one factor in the problem.

Unquestionably, the difference in results under different hours-of-work schedules is attributable in many cases to differences in efficiency of management. On the other hand, it may be that an establishment which failed to maintain production on a 54-hour week may be quite as efficient as one which maintained production on a 50-hour week; the difference in result may be due to differ-



ences in the nature of the process, in the character of the raw material, in the type of machinery, or in the type of worker employed.

Exact mathematical measurement of the effect of changes in hours alone is not possible. Conclusions must necessarily be drawn in a broad way. The value of this study of experience in the metal trades lies in its positive evidence that it is possible not merely for occasional and exceptional establishments but for a considerable proportion of establishments to maintain production on a schedule of 50 hours per week, and that a 48-hour week is a practicable one for a limited proportion of establishments in these industries. Whether such schedules are practicable in individual cases is a problem for the particular establishment to determine. It is obviously to the interest of employers to make a thorough study of conditions in their respective plants in the light of the evidence presented in this report.

## HEALTH OF METAL WORKERS

Conclusions as to the effects of reductions in hours of work on health of workers in the metal trades industries cannot be reached at this time, for the reason that data covering a sufficient period of time to permit satisfactory study are not in existence.

Of those establishments replying on this point, 8 reported an improvement in health conditions following reductions in hours to 50 or 48 a week; 84 others reported no noticeable change. In many instances, however, the statements were based on opinion only. In the absence of a definitely recognized standard for the measurement of health conditions such opinions cannot be given the same weight as those concerning output. Furthermore, it is necessary to take into account the effects of a great number of collateral factors which unquestionably have an important bearing. As was stated in an earlier report on the hours-of-work problem,<sup>1</sup> "such influences as nationality, inheritance, personal hygiene and habits have a very important bearing on health, so that even though a change in hours of work may have a significant effect, this may be overshadowed by the collective effect of other factors."

Thus, a representative of a large establishment conducting practically all branches of metal manufacturing stated:

Inasmuch as several changes were made at the same time, it is impossible to say how much of the benefit which followed was due to any one matter. It is impossible to say how far we can attribute better conditions to the introduction of the eight-hour day. We are convinced, however, that the shorter day does conduce to larger output, better quality of work, better health conditions, to the decrease in number of accidents, and to the contentment of our workers.

As noted in its report on the hours-of-work problem in the silk industry, the National Industrial Conference Board secured the co-operation of a large number of manufacturing establishments for the keeping of absence records in industry for a 24-day period in 1918 and a similar period in 1919. While such records will throw little light on the effect of hours of work on health until kept over long periods, they should be of value in arriving

<sup>1</sup>Research Report No.16, "Hours of Work as Related to Output and Health of Workers — Silk Manufacturing."

at broad conclusions regarding general health conditions in industry. Furthermore, it is hoped that the keeping of these records for specific periods may lead to keeping them permanently by leading manufacturing establishments and thus provide a basis for determining the underlying causes of sickness and result in preventive measures. Only by careful compilation of such data showing the amount and the causes of absence in a large number of industrial establishments will it be possible to present valid conclusions as to the effects of hours of work or other specific industrial factors upon the health of workers. Such data should, however, be supplemented by intensive study of other factors as well.<sup>1</sup>

#### GENERAL HEALTH CONDITIONS IN THE METAL MANUFACTURING INDUSTRIES

Factory conditions in metal manufacturing establishments vary greatly, a reflection, in part at least, of differences in the legal requirements of the various states. Some establishments are models of modern sanitary engineering and go far beyond requirements of the law, while other establishments are rendered more or less hazardous by dampness, metallic dust, extremes of temperature, insufficient ventilation and poor lighting, the latter feature being perhaps most common.

Statements of manufacturers furnished in the course of this investigation indicated that, on the whole, health conditions in metal manufacturing compare favorably with those in other manufacturing industries.

Certain occupational diseases, such as lead and brass poisoning, are prevalent in the metal trades; lead poisoning, however, is not characteristic of the particular branches of the metal manufacturing industry included in this investigation. In some processes acid and other fumes introduce an occupational hazard.<sup>2</sup>

#### TUBERCULOSIS AMONG METAL TRADES WORKERS

However, the death rate from tuberculosis in certain branches of the metal manufacturing industry is high. This is clearly shown by Table 5, compiled from data collected in the United States Census of 1909.

<sup>1</sup> See footnote, p. 41. Research Report No. 16.

<sup>2</sup> Thus E. R. Hayhurst, in "Industrial Health-Hazards and Occupational Diseases in Ohio" (1915), reports after a study of 52 forging and blacksmithing plants: "Poisoning by fumes or otherwise was a serious hazard in 23 plants, fairly so in 6 more, and negligible in the remaining 23. The chief danger was from chronic gassing, due to the escape of fuel fumes and smoke. In addition, tempering and case hardening with lead, potassium cyanide and oil, were carried on in a number of blacksmith shops."

TABLE 5: PERCENTAGE OF DEATHS OF MALES FROM VARIOUS CAUSES, FOR CERTAIN OF THE METAL TRADES AND FOR WORKERS IN ALL MANUFACTURING AND MECHANICAL PURSUITS, BY SPECIFIED AGE GROUPS

(Compiled from U. S. Census, Mortality Statistics, 1909)

CAUSE OF DEATH	All ages 10 years and over		25 to 34 years		35 to 44 years		45 to 54 years	
	Iron and <sup>a</sup> Steel Products	All Mfg. and Mech.	Iron and <sup>a</sup> Steel Products	All Mfg. and Mech.	Iron and <sup>a</sup> Steel Products	All Mfg. and Mech.	Iron and <sup>a</sup> Steel Products	All Mfg. and Mech.
Tuberculosis of lungs . . . . .	18.9	15.5	35.1	30.8	25.7	25.0	14.2	15.6
Heart disease . . . . .	11.1	11.4	4.6	4.8	7.8	7.2	14.5	10.7
Other diseases of circulatory system . . . . .	4.1	4.0	1.9	1.4	2.7	2.2	2.9	3.4
Apoplexy and paralysis . . . . .	6.5	7.2	1.7	1.1	1.7	2.6	4.4	5.7
Other diseases of nervous system . . . . .	2.4	2.4	2.3	2.2	2.3	2.7	2.2	2.6
Cancer . . . . .	4.8	5.6	1.3	1.5	3.4	3.6	7.9	6.6
Pneumonia . . . . .	7.7	7.9	5.9	7.0	8.7	9.1	9.8	9.0
Bright's disease . . . . .	7.9	8.6	4.0	3.8	4.4	6.5	11.1	9.7
Cirrhosis of liver . . . . .	1.3	1.9	0.2	0.8	1.9	1.9	1.3	2.8
Alcoholism . . . . .	0.8	0.9	0.6	0.8	2.3	1.6	1.0	1.4
Diabetes . . . . .	1.2	1.1	1.3	0.8	1.1	0.8	1.0	1.1
Typhoid fever . . . . .	2.9	2.0	5.8	4.7	3.0	2.5	1.0	1.4
Occupational and chronic poisoning . . . . .	0.0	0.1	0.0	0.1	0.0	0.2	0.0	0.2
Suicide . . . . .	3.5	2.8	5.2	4.0	4.0	3.6	4.0	3.8
Accidents . . . . .	9.4	11.1	13.3	20.7	10.8	15.6	8.4	10.1
Other causes . . . . .	17.5	17.5	16.8	15.5	20.2	14.9	16.3	15.9
<i>Total</i>	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

<sup>a</sup> This table includes machinists; steam-boiler makers; stove, furnace and grate makers; and tool and cutlery makers.

This table shows for certain age groups an excessive death rate from tuberculosis, but on the whole the health hazard for these industries appears to compare not unfavorably with the average for all manufacturing and mechanical pursuits combined. The accident rate, while comparatively high, is nevertheless lower for each age group than the average rate for workers in all manufacturing and mechanical industries combined. The death rate from occupational and chronic poisoning, it will be seen, was almost insignificant.

Table 6, also compiled from United States Mortality Statistics, shows the percentage of deaths from tuberculosis in certain specific branches of the metal trades, with comparisons for the three textile industries discussed in previous reports of the Board.

TABLE 6: PERCENTAGE OF DEATHS OF MALES DUE TO TUBERCULOSIS, OF THE TOTAL MORTALITY FOR CERTAIN OCCUPATIONS AND FOR ALL MANUFACTURING PURSUITS, BY AGE GROUPS  
(Compiled from U. S. Census. Mortality Statistics, 1909)

Occupation	Age Groups						
	All ages 10 and over	15 to 19	20 to 24	25 to 34	35 to 44	45 to 54	55 to 64
Machinists . .	18.3	23.9	36.9	35.0	23.8	13.1	7.2
Tinplate and tinware makers	18.9	40.0	25.0	37.0	32.5	17.9	7.4
Brass workers .	31.8	50.0	68.4	50.0	31.4	16.7	15.4
Other metal workers . .	17.9	25.0	38.9	34.1	22.6	15.6	6.8
Silk workers . .	19.8	27.7	50.0	29.8	28.5	13.3	7.0
Wool workers .	22.3	30.8	44.8	41.7	35.3	16.7	13.6
Cotton workers	21.1	19.6	48.8	37.8	27.1	19.4	9.4
All manufactur- ing and me- chanical pur- suits . . . .	15.5	22.1	32.5	30.8	25.0	15.6	8.2

The most conspicuous feature of this comparison is the very high tuberculosis death rate for brass workers. The rate for tinplate and tinware workers also is high. For machinists and "other metal workers," however, the rates are on the whole lower than those for textile workers.

Table 7 shows the percentage of deaths due to tuberculosis in certain branches of the metal manufacturing industry where the dust hazard is especially marked, as reflected by the industrial experience of the Prudential Insurance Company.

TABLE 7: MORTALITY FROM TUBERCULOSIS OF THE LUNGS IN OCCUPATIONS EXPOSING WORKMEN TO METALLIC DUST — MALES 1907 TO 1912.\* INDUSTRIAL MORTALITY EXPERIENCE, PRUDENTIAL INSURANCE COMPANY OF AMERICA

	Deaths at Ages 25-34 from		Deaths at Ages 35-44 from	
	All Causes	Tuberculosis of the Lungs	All Causes	Tuberculosis of the Lungs
Chippers, Foundries . . . . .	2	50.0	6	50.0
Wire weavers . . . . .	6	50.0	5	60.0
Cutlery makers . . . . .	9	44.4	10	40.0
File makers . . . . .	10	70.0	10	60.0
Grinders and polishers . . . .	28	64.3	27	66.7
Brass workers . . . . .	47	68.1	79	46.8
Tool makers . . . . .	25	40.0	33	48.5
Miscellaneous metal workers . .	37	48.6	25	44.0
Polishers, not specified . . .	75	56.0	91	42.9
Die setters . . . . .	7	14.3	..	....
Total for group . . . . .	246	55.3%	286	47.9%
Non-dusty occupations . . . . .	..	40.1	..	32.2

\*A few occupations given in the original table but not covered by the Board's investigation, for example, gold-beaters, jewelers, and printers, have been omitted from this table, and the averages recomputed to allow for this.

The weighted average for the ten occupations covered in this table shows a death rate from tuberculosis distinctly higher than the rate for the so-called non-dusty occupations. In many cases the basis of experience is too limited to permit of conclusions.

The dust hazard is apparently due chiefly to the injury caused the membranes, rather than to any infectious quality of the dust itself.

Iron is in no sense a chemical irritant to the body, being a natural ingredient of the hemoglobin. Iron and steel dust, however, by virtue of the hardness and sharpness of the particles, are irritant to the bronchial mucosa when inhaled, and foster the development of fibroid phthisis and subsequent acquisition of pulmonary tuberculosis.<sup>1</sup>

Table 8, based on the experience of the Prudential Insurance Company, also shows a high death rate from tuberculosis for toolmakers and instrument makers. It will be noted that it covers a different period and a different group of workers than the toolmakers included in Table 7.

<sup>1</sup>W. Gilman Thompson, M.D., "The Occupational Diseases," p. 191.

TABLE 8: MORTALITY FROM PULMONARY TUBERCULOSIS AMONG TOOL AND INSTRUMENT MAKERS, INDUSTRIAL EXPERIENCE OF PRUDENTIAL INSURANCE COMPANY, 1897 TO 1914, COMPARED WITH THAT OF ALL MALES IN UNITED STATES REGISTRATION AREA, 1900 TO 1913, BY AGE GROUPS\*

Age at death	Deaths of toolmakers and instrument makers. 1897 to 1914		Percent of deaths from pulmonary tuberculosis	
	All Causes	Pulmonary Tuberculosis	Toolmakers and Instrument Makers	Males in registration area, 1900 to 1913
15 to 24 years . . .	88	33	37.5	27.0
25 to 34 years . . .	93	49	52.7	30.5
35 to 44 years . . .	111	41	36.9	23.4
45 to 54 years . . .	98	33	33.7	14.7
55 to 64 years . . .	67	7	10.4	7.9
65 years and over . . .	76	7	9.2	2.6
Total, 15 years and over . . . . .	533	170	31.9	13.9

\*Bureau of Labor Statistics Bulletin No. 231: "Mortality from Respiratory Diseases in Dusty Trades," by Dr. Frederick L. Hoffman, p. 109.

In comparing the death rates from tuberculosis for tool and instrument makers given in the above table with the rates for males in the registration area as reported by the Census, it must be remembered that the latter include workers in several outdoor industries characterized by a comparatively low death rate from tuberculosis, as, for instance, farmers.<sup>1</sup> A comparison for tool and instrument makers with the average for workers in all manufacturing and mechanical pursuits, as given in Table 5 is, however, highly unfavorable to the former group. These rates indicate an excessive waste of life from this disease among workers in these occupations.

#### GENERAL CAUSES OF DEATH IN SPECIFIC OCCUPATIONS

A table submitted by the general secretary-treasurer and editor of the Brass Workers' Union of North America<sup>2</sup> for the five-year period from 1909 to 1914 covering the death claims paid, showing chief causes of deaths, numbers, and percentages in that industry, follows:

<sup>1</sup> Thus, according to the Census of 1909, deaths among farmers, planters and overseers from tuberculosis represented 6.6% of the total deaths from all causes. The corresponding figure for all persons engaged in agricultural pursuits was 8.7%.

<sup>2</sup> Cited by Dr. E. R. Hayhurst, "Industrial Health-Hazards and Occupational Diseases in Ohio" — 1915.

TABLE 9: DISTRIBUTION OF CAUSES OF DEATHS AMONG MEMBERS OF BRASS WORKERS' UNION OF NORTH AMERICA, 1909 to 1914

Cause	Number	Per Cent
Tuberculosis . . . . .	77	31.9
Pneumonia . . . . .	31	12.9
Heart disease . . . . .	31	12.9
Violence (including 6 suicides) . . . . .	19	7.9
Other preventable deaths . . . . .	20	8.0
Other deaths from degenerative diseases . . . . .	57	23.5
All other deaths (classed as "permissible") . . . . .	7	2.9
Total . . . . .	242	100.0

In this table it will be seen that deaths from tuberculosis are considerably more than twice as numerous as for any other single disease. This is in line with other evidence of an exceptionally high mortality from tuberculosis among brass workers.

As an illustration of major causes of absence among molders, the following table showing the distribution of the amount of time for which compensation was paid by the International Molders' Union in the four-year period 1913 to 1916 is of interest:

TABLE 10: DISTRIBUTION OF TOTAL TIME FOR WHICH SICK BENEFITS WERE PAID BY THE INTERNATIONAL MOLDERS' UNION, 1913 TO 1916

Rheumatism . . . . .	13.7 %
Tuberculosis . . . . .	3.0
Accident . . . . .	15.25
Burns . . . . .	8.67
Throat and Lungs . . . . .	17.4
Stomach . . . . .	4.28
Lumbago, Sciatica, Neuritis . . . . .	5.3
Heart, Liver, Kidney, Bladder . . . . .	5.6
Intestines and Rectum . . . . .	5.2
Miscellaneous . . . . .	21.6

The Reports of Vital Statistics for the State of Ohio covering the years 1910, 1911, and 1912 show that of 605 molders who died during that period 110 deaths, or 18.18%, were due to pulmonary tuberculosis. Of 1,195 deaths of machinists in the same period, tuberculosis was responsible for 224, or 18.74%, as against 13.3% for all occupations in Ohio.<sup>1</sup>

The Financier of the International Molders' Union of North America, referring to the Ohio branch, stated

<sup>1</sup>Cited by Dr. E. R. Hayhurst, "Industrial Health-Hazards and Occupational Diseases in Ohio." — 1915.



that during the five-year period ending in 1913 the Union recorded 204 deaths for which benefits were paid. The chief causes of death were as follows, in order: pneumonia, 30; heart trouble, 30; tuberculosis, 27; violence, 18. It will be seen that this comparison shows an unusually high death rate from pneumonia as well as from tuberculosis. One explanation of this is the change from extremes of heat and cold which characterizes the foundry industry, it being not unusual for workers after laboring in the presence of excessive heat to go immediately into cold air.

While the basis of experience included in the foregoing tables is doubtless too limited to permit of definite conclusions as to the ratio of deaths from tuberculosis in the several branches of the metal manufacturing industry, the evidence is clear that for a part of the industry the death rate from tuberculosis is exceedingly and unnecessarily high. It should, however, be pointed out that in general the branches characterized by exceptionally high death rates from this disease employ a relatively small proportion of the workers in the industry. It is obviously incumbent upon industrial managers to make intensive study of the conditions peculiar to these branches of the industry, with a view to devising some means for bringing about a reduction in this excessive rate. Furthermore, the rate is so high for the industry as a whole as to call for careful study of general working conditions and more exact knowledge of the causes contributing to tuberculosis. Until this is done no definite constructive policy can be laid down. In view of the fact, however, that tuberculosis is a disease more or less common to the human race in all walks of life, such a study must embrace conditions outside of the factory as well as those within the factory walls.

As an illustration of the importance of studying these other factors as well as conditions within the factory, the following statement may be cited:<sup>1</sup>

The familiar Berlin statistics showed that 42 per cent of all the cases of tuberculosis occurred in families occupying but one room, 40 per cent where they occupied two rooms, 12 per cent where they occupied three rooms, and only 6 per cent where they occupied four or more rooms. Williamson presented English statistics which showed that 60 or 70 per cent of the cases of tuberculosis occurred in houses of three

<sup>1</sup>British Journal of Tuberculosis, IX, pp. 111-117, July, 1915.

rooms or less and that the number of cases was larger in two-room houses than in three, and larger in one-room houses than in two.

In connection with this statement the question should, however, be borne in mind as to how far these crowded housing conditions may have been due to a low wage. There is considerable evidence to indicate that there is a definite connection between the prevalence of tuberculosis and inadequate nourishment and poor housing conditions. Racial characteristics and personal habits must also be carefully considered.

### ACCIDENT HAZARD

Owing to the great variety and intricacy of much of the machinery used, the high speed at which it is often operated, the use of acids and poisons, and the intense heat characteristic of certain operations, the accident hazard in the metal manufacturing industry is comparatively high. Thus in the State of Ohio the insurance rate per \$100 of wages paid, as indicated by the rate manual of that state, shows a distinctly higher accident hazard for metal manufacturing than that for several other leading industries.<sup>1</sup> As noted on page 33 however, census returns show a lower average death rate from accident for the industries covered by this report than the average for all manufacturing and mechanical industries combined.

<sup>1</sup>The following table shows the rates for various industries as quoted in the Ohio Rate Manual in effect July 1, 1918:

Boot and shoe manufacturing . . . . .	\$ .24
Silk manufacturing . . . . .	.25
Wool combing . . . . .	.25
Printing . . . . .	.26
Textile dyeing, finishing, and printing . . . . .	.30
Rubber garment manufacturing . . . . .	.50
Rubber tire manufacturing . . . . .	.65
Wool spinning and weaving . . . . .	.65
Shoe stock manufacturing . . . . .	.70
<b>Blacksmithing exclusive of shoeing</b> . . . . .	<b>.80</b>
<b>Electric apparatus manufacturing</b> . . . . .	<b>.80</b>
Cotton spinning and weaving . . . . .	.85
<b>Brass foundry</b> . . . . .	<b>.90</b>
Automobile manufacturing . . . . .	.95
Earthenware and clay pipe manufacturing . . . . .	1.10
Pulp manufacturing, no saw or barking mills . . . . .	1.10
Blacksmithing and shoeing . . . . .	1.15
<b>Auto parts (sheet metal), etc.</b> . . . . .	<b>1.16</b>
Can manufacturing . . . . .	1.20
<b>Machine shop, without foundry</b> . . . . .	<b>1.25</b>
<b>Pattern making</b> . . . . .	<b>1.25</b>
<b>Molding</b> . . . . .	<b>1.35</b>
<b>Machine shop, with foundry</b> . . . . .	<b>1.45</b>
Wool pulling . . . . .	1.50
<b>Iron Foundry</b> . . . . .	<b>1.55</b>
Rolling mills . . . . .	1.75
<b>Machinists</b> . . . . .	<b>2.10</b>
<b>Boilermaking</b> . . . . .	<b>2.20</b>
<b>Steel castings</b> . . . . .	<b>2.40</b>
Paper manufacturing, except writing and bond and ledger . . . . .	2.55
Blast furnace operatives . . . . .	3.25
Sawmills . . . . .	3.85

## CONCLUSIONS AS TO HEALTH

While definite conclusions as to health hazards in the metal trades cannot be reached from the evidence at present available, on the whole it appears that the worker in these industries occupies a fairly favorable position, judged by the average hazards of industrial employment. The tuberculosis death rate for certain occupations, such as brass working, is exceptionally high. This unfavorable condition is, fortunately, modified by the fact that those occupations having an unusually high tuberculosis death rate include a relatively small number of workers. The tuberculosis death rate for the industry as a whole, however, as for many other industries, is excessive, but until much more is known as to the influence of housing conditions, personal habits and hygiene, and racial or family predisposition, the responsibility of industry alone cannot fairly be measured. As noted in a similar report on the cotton manufacturing industry there is an increasing tendency among those making scientific study of the tuberculosis problem to attach more weight to these outside factors than to the occupation itself.<sup>1</sup> This does not relieve the industry, or such a specific factor as the length of the work-week, from its full share of responsibility. But any constructive policy for reducing the prevalence of this disease among industrial workers must give due consideration to the other factors in the problem.

<sup>1</sup> National Industrial Conference Board. Research Report No. 4, "Hours of Work as Related to Output and Health of Workers — Cotton Manufacturing," p. 55, footnote.



## Appendices

Tables A and B epitomize the important data submitted by those establishments which reported the effects on output accompanying reductions in work-hours. For convenience, the information is assembled by hour groups and the establishments classified according to the effect on production. A separate classification by branches of the industry was not made, as no characteristic differences in experience in this respect was apparent.

In previous reports of this series changes in rates of wages accompanying reductions in hours were individually noted in the appendix. In the case of the metal trades, rates of wages were almost invariably increased at the time of the reduction in work schedules and in a great proportion of cases were increased to a compensating degree. A detailed statement of changes in wage rates would, therefore, throw little additional light on the problem and in order to economize space this information has been omitted.

# Appendix A

## Results Reported in Replies to the 1917 Questionnaire

### REDUCED TO 45 HOURS

#### Production Maintained

Establishments . . . . .	1
Employees . . . . .	278

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
1917	50	278	Steel tubes.	Production has been maintained.

### REDUCED TO 48 HOURS

#### Production Increased

Establishments . . . . .	5
Employees . . . . .	37,499

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
1915	60	69	Small tools and machinery.	5 to 10% increase.
1915	55	2,509	Machine parts.	Production increased slightly.
1916	54	124	Machinery.	Increase of output due to improved methods.
1914	54	34,571	Automobiles.	Production increased between 15% and 20%.
1916	54	226	Automobiles.	Quality of work improved and quantity increased.

#### Production Maintained

Establishments . . . . .	13
Employees . . . . .	9,167

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
1913	60	1,270	Hardware.	Records do not show any appreciable change.
1907	60	273	Farm tools.	Production almost as great. Men speed up.
1914	55 <sup>a</sup>	44	Small tools.	Pieceworkers maintained. Day-workers practically so.
1916	55	600	Heavy sheet metal products.	No important loss of product.
1915	54	360	Pipes and sheet metal products.	Output maintained.
1916	54	125	Iron castings.	Men work more steadily and output has been maintained.
1915	54	3,806	Automobiles.	Quantity and standard of production maintained.
1917	54	202	Auto trucks.	Better satisfied workmen. Production of 8 hours equal to that of 9.
1914	53	325	Machine tools.	Output maintained and better in quality.

<sup>a</sup> This establishment reduced to 47½ hours.

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
1917	52½ <sup>a</sup>	385	Small tools.	Daily rate of output the same.
1916	50	423	Machine parts.	Normal output retained by slightly higher pressure. A few automatic machines were added.
1915	50	618	Machine parts.	Output maintained; quality improved.
1915	50	736	Telephone appliances.	Satisfied that most employees are turning out as many parts now in 48 hours as they formerly did in 50.

### Production Decreased

Establishments . . . . .	23
Employees . . . . .	9,238

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
1915	60	80	Machinery and tools.	Decrease in output.
1915	55	154	Meters.	Less production.
1917	55	30	Automatic apparatus.	Slightly less output.
1915	55	640	Silverware.	A decrease in output less than proportional to the reduction in hours.
1916	55	325	Metal products.	Production correspondingly decreased.
1915	55	1,900	Automobiles.	Proportional reduction in output per operator.
1917	55	247	Machinery.	Less work.
1917	54	172	Machinery.	Corresponding reduction of output.
1916	54	353	Machinery.	On the whole a loss in output. A few workers succeed in doing 9 hours work in 8 hours.
1917	54	609	Machinery.	5 to 10% decrease in daywork.
1917	54	550	Machine tools.	Weekly output decreased proportionally.
1917	54	554	Machinery.	10% decrease.
1917	54	89	Machinery.	Output decreased in proportion to time.
1917	54	529	Steel tanks.	Output decreased in proportion to time.
1915	54	284	Machine tools.	Less work done.
1915	54	362	Machinery.	Loss of production.
1915	54	200	Chains.	Reduction in day and piece work. We were already at our limit as far as speed of machines and operators was concerned.
1916	53	46	Machinery.	Production per hour remains same as before.
1916	52½	250	Hardware.	Decrease in day and piece work of 10%.
1915	52½	771	Magnetos.	Weekly output decreased.
1917	50	904	Auto starters.	Piece and day work decreased 4%.
1917	50	40	Machine parts.	Decrease in output. More overtime required to complete contracts.
1917	49½	149	Steel tanks and pipes.	Diminished production.

<sup>a</sup> This establishment reduced to 47½ hours.

## REDUCED TO 49½ HOURS

### Production Increased

Establishments . . . . .	2
Employees . . . . .	334

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
1916	55	148	Electrical appliances.	Better feeling, also increased production.
1917	52	186	Special machinery.	A greater production in the shorter hours.

### Production Maintained

Establishments . . . . .	1
Employees . . . . .	488

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
1915	55	488	Automobiles.	No appreciable reduction in output.

### Production Decreased

Establishments . . . . .	4
Employees . . . . .	1,428

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
1917	55	385	Automobiles.	Small decrease in output.
1902	55	776	Steel castings.	Production of daywork decreased proportionally.
1902	55	167	Iron castings.	Proportional reduction in output.
1917	54	100	Iron castings.	Decrease of about 5% in production.

## REDUCED TO 50 HOURS

### Production Increased

Establishments . . . . .	4
Employees . . . . .	3,424

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
1917	55	189	Silverware.	Records show an increased production.
1913	55	69	Machinery.	Increased production.
1916	54	3,126	Office machinery.	We experienced a decided increase in production. Daywork increased 10%. Piecework increased 5%.
1916	54	40	Hardware.	Increase probably 20% in piecework; 75% of workers are on piecework.

### Production Maintained

Establishments . . . . .	28
Employees . . . . .	33,349

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
1916	60	320	Machinery.	No material change.
1916	59	965	Automobiles.	Increase in output per hour 15%. No piecework.
1910	59	377	Machinery.	Production maintained.
1913	57	10,030	Automobiles.	No effect on output, change affecting only Saturday afternoon.



Date of Change	Previous Hours	Number Employees	Product	Statement of Management
1916	56 $\frac{1}{4}$	172	Machinery.	Output about the same.
1916	55	101	Steam blowers and iron castings.	Weekly output maintained.
1917	55	447	Small tools.	Production maintained. Employees attend more strictly to business and there is less absence.
1917	55	450	Small tools.	Output is maintained.
1915	55	2,760	Machine parts.	Maintained for the most part.
1917	55	154	Machinery.	Output about the same.
1917	55	146	Machine parts.	Output maintained.
1908	55	8,070	Steel castings.	No apparent effect in production or costs.
1916	55	600	Alloy castings.	No important effects noticed.
1917	55	287	Automobiles.	Total weekly output maintained.
1916	55	482	Automobiles.	Same output; better satisfied men.
1913	55	737	Instruments and transformers.	Believed we would get equal amount of work and better quality in 9 hours than in 10. This has proven true.
1916	55	199	Electrical apparatus.	Output unchanged.
1914	54	514	Engines.	By the Emerson standard we get as much from the 50-hour as we did from the 54-hour schedule.
1917	54	750	Electric motors.	Speeded up production; concluded we could get about all there was in the employees out of them in 50 hours per week.
1916	54	504	Machine accessories.	No appreciable reduction in production.
1912	54	289	Farm implements.	No noticeable change.
1917	54 <sup>b</sup>	175	Special hardware.	Output same as before change.
1917	54	268	Steel tanks.	Output maintained.
1912	54	302	Machinery.	Perceptible increase at first but gradually returned to normal conditions.
1915	53	112	Machine tools.	No noticeable effect anywhere.
1915	52 $\frac{1}{2}$	336	Plumbers' tools.	No appreciable loss in production by the change.
1916	52 $\frac{1}{2}$	3,496	Machine parts.	No change in output.
1916	52	306	Office appliances.	Output maintained.

### Production Decreased

Establishments . . . . .	34
Employees . . . . .	33,026

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
1912	60	37	Machinery.	Decrease of 10% in output.
1907	60	29	Machinery.	Decrease of 10% in output.
1917	57 $\frac{3}{4}$	32	Hardware.	Piecework maintained; daywork decreased 11%.

<sup>b</sup> Reduced to 50 $\frac{1}{2}$  hours.

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
1917	55*	707	Machinery.	Proportional loss in output.
1915	55	236	Hardware.	In a few cases some improvement, but in most cases less work.
1916	55	394	Hardware.	About 10% <sup>5</sup> / <sub>16</sub> less output. Effort to get same <sup>4</sup> / <sub>16</sub> production only partly successful.
1916	55	3,819	Automobiles.	Production somewhat reduced.
1915	55	1,101	Automobiles.	Records kept for three months before and after change show that amount of work per man per hour remained same.
1914	55	455	Valves and hydrants.	Less than proportional decrease for whole mill. Pieceworkers decrease 5%.
1916	55	340	Machinery.	Proportional decrease in output.
1915	55	460	Machinery.	Less production per man.
1915	55	118	Office appliances.	Weekly output decreased.
1917	55	97	Wire products.	Production decreased.
1916	55	593	Sheet metal.	Decrease in production; somewhat better attendance.
1902	55	578	Marine engines.	Output decreased more than in proportion to reduction in hours.
1902	55	100	Machine parts.	Output decreased 10% per man.
1917	54	1,034	Farm implements.	Daywork <sup>3</sup> / <sub>16</sub> output decreased about 5%. Piecework maintained.
1915	54	163	Welding apparatus.	Proportional decrease.
1917	54	56	Office appliances.	Output decreased; no piecework.
1901	54	723	Fire fighting apparatus.	Proportional decrease.
1904	54	10	Machinery.	A reduction in output.
1901	54	244	Meters.	Output reduced; percentage not known.
1916	54	49	Special machinery.	Output decreased.
1916	54	149	Wire products.	Output decreased; men speeded up somewhat.
1916	54	1,808	Machinery.	Decrease greater than proportional to the reduction in hours, partly on account of inexperienced help.
1916	54	631	Machinery.	Slight decrease in output.
1915	54	2,760	Automobiles.	Approximately 7% decrease in output.
1915	54	314	Automobiles.	Small reduction.
1914	54	269	Electrical appliances.	Proportional decrease. When our machinery stops, production also stops.
1916	53 <sup>3</sup> / <sub>4</sub>	569	Electrical apparatus.	Increased production through greater force, etc., offset result of lesser hours.
1916	53	196	Architectural iron.	No change <sup>7</sup> / <sub>16</sub> in hourly production.
1916	52 <sup>1</sup> / <sub>2</sub>	1,868	Wires and cables.	Output decreased.
1917	52	13,075	Electrical apparatus.	Pieceworkers maintained, dayworkers decreased, but not in proportion.
1916	51 <sup>3</sup> / <sub>4</sub>	12	Electrical apparatus.	Slight decrease in output.

\*Foundry, 60 to 55.

## REDUCED TO 51 HOURS

### Production Maintained

Establishments . . . . .	3
Employees . . . . .	1,100

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
1904	55½ <sup>a</sup>	126	Hardware.	Tried it out and found we produced as much in 5½ days.
1917	54	474	Gas appliances.	Output remains the same.
1917	54 <sup>b</sup>	500	Auto trucks.	No decrease in production.

### Production Decreased

Establishments . . . . .	3
Employees . . . . .	1,453

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
1917	54	155	Machinery.	Less production.
1916	54	631	Machinery.	Decrease in production.
1916	54	667	Valves.	Slight decrease in output.

## REDUCED TO 52 HOURS

### Production Increased

Establishments . . . . .	1
Employees . . . . .	262

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
—	55	262	Auto trucks.	Output increased. Most noticeable in the assembly departments.

### Production Maintained

Establishments . . . . .	1
Employees . . . . .	23,850

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
1915	54	23,850	Electrical apparatus.	Our output remained practically the same.

### Production Decreased

Establishments . . . . .	2
Employees . . . . .	3,503

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
1917	55	250	Sheet metal products.	Estimated decrease of 15% in output.
1915	54	3,253	Railroad supplies.	Piecoworkers increased output.

## REDUCED TO 52½ HOURS

### Production Increased

Establishments . . . . .	3
Employees . . . . .	1,744

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
1917	56½	36	Machine parts.	Output slightly increased.
1915	55	600	Machine tools.	Output increased; greater satisfaction and loyalty among employees.

<sup>a</sup> Hours in this establishment, 51¼ per week.

<sup>b</sup> Hours in this establishment, 51¼ per week.

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
1913	55	1,108	Machinery.	Proportional reduction for a time. However as a result of more complete time studies, improved tools and special machinery, our output was later increased to above what we turned out in 55 hours.

### Production Maintained

Establishments . . . . .	14
Employees . . . . .	7,586

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
1910	57	20	Ironwork for buildings.	Output about the same.
1916	55	786	Machinery.	Output maintained.
1914	55	603	Machine tools.	Output maintained.
1916	55	411	Machine tools.	Output maintained.
1917	55	40	Machinery.	Output maintained; better time kept among employees.
1916	55	44	Architectural iron.	Output about the same as before change in hours.
1916	55	111	Meters.	Output maintained; both piece and day workers producing more per hour.
1913	55	1,198	Engineering specialties.	Output maintained; increase in efficiency.
1915	55	649	Machinery.	Change in output not noticeable.
1917	55	1,161	Machine parts.	About the same output.
1917	55	711	Machinery.	No reduction in output.
1913	55	136	Engineering specialties.	Output maintained.
1916	54	684	Appliances.	Output maintained; more steadiness in attendance.
1914	53	1,032	Special hardware.	Same output as before change in hours.

### Production Decreased

Establishments . . . . .	14
Employees . . . . .	6,431

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
1913	60	140	Machinery.	Diminished output of machine tools having a fixed rate of speed. Otherwise no effect observable.
1907	58	225	Machinery and castings.	Production reduced.
1916	57½	87	Machinery.	Less work turned out.
1916	55	70	Special railroad equipment.	Output decreased.
1917	55	831	Machinery.	Proportional decrease.
1913	55	98	Motor fire apparatus.	Output decreased 5%.
1913	55	155	Machine tools.	Output decreased 5%.
1913	55	246	Machinery.	Output decreased.
1913	55	46	Machine tools.	Less production.

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
1917	55	1,500	Electrical appliances.	No change in piecework; a slight decrease in daywork.
1916	55	632	Machinery.	Output decreased.
1916	55	972	Machinery.	Decrease in weekly output 5%.
1916	55	550	Machinery.	Decrease of 5% in daywork; no change in piecework.
1915	54	879	Machine parts.	Output decreased 3%.

**REDUCED TO 53 HOURS  
Production Increased**

Establishments . . . . .	1
Employees . . . . .	71

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
1915	59	71	Sheet metal products.	Production of previous year was not only equaled but considerably increased.

**Production Maintained**

Establishments . . . . .	3
Employees . . . . .	613

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
1917	59	69	Machinery.	Output maintained.
1917	59	334	Electrical appliances.	Production did not change appreciably.
1910	54	210	Household and office appliances.	Production maintained.

**REDUCED TO 53¼ HOURS  
Production Maintained**

Establishments . . . . .	1
Employees . . . . .	500

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
1916	57½	500	Auto horns, fans, etc.	Production remains about the same.

**Production Decreased**

Establishments . . . . .	1
Employees . . . . .	153

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
1917	57½	153	Machinery.	Decreased output.

**REDUCED TO 54 HOURS  
Production Increased**

Establishments . . . . .	2
Employees . . . . .	825

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
1913	59	729	Special vehicles.	Output increased.
1916	59	96	Marine hardware.	More production.

### Production Maintained

Establishments . . . . . 17  
Employees . . . . . 22,185

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
1917	60	466	Hardware.	Output maintained; a merit bonus system installed.
1902	60	7,493	Railway supplies.	No important effects.
1907	60	134	Iron castings.	Output maintained.
1917	60	820	Stoves.	Output maintained by both day and pieceworkers.
1910	60	427	Steel castings.	Output maintained.
1916	60	462	Iron castings.	No change in output.
1913	60	205	Machinery.	Production about the same.
1917	60	670	Farm implements.	Almost same production.
1915	60	1,406	Machinery.	Maintained. Partly due to speeding up machines.
1913	60	402	Machinery and castings.	Output maintained.
1902	60	2,128	Office appliances.	The employees seem to be better satisfied and the company gets just as much work.
1914	60	64	Machine parts.	Approximately as much output in 9 hours as was formerly gotten out in 10.
1914	60	2,733	Machine parts.	Output maintained; men speeded up.
1907	59	237	Architectural iron.	No noticeable change.
1916	56	200	Power transmitting machinery.	No difference in output.
1916	56	32	Small tools.	No noticeable change.
1913	55	4,306	Automobiles.	Same amount of work accomplished in 9 hours as formerly in 10.

### Production Decreased

Establishments . . . . . 33  
Employees . . . . . 14,197

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
1903	61	76	Plumbers' supplies.	Total weekly output decreased.
1912	60	294	Plumbers' supplies.	Total weekly output decreased.
1914	60	160	Iron and aluminum castings.	Production reduced proportionally.
1914	60	60	Iron castings.	Production decreased proportionally.
1912	60	79	Iron castings.	Production largely curtailed.
1906	60	112	Machinery.	Proportional decrease.
1903	60	525	Machine appliances.	Proportional decrease.
1912	60	316	Machinery and tools.	Production reduced 10% for dayworkers; 5% for pieceworkers.
1916	60	254	Machinery.	Decreased production.
1916	60	768	Edged and farm tools.	Daywork decreased 10%; piecework maintained.
1900	60	249	Boilers.	Output decreased proportionally.
1911	60	126	Machinery.	Output decreased 10%.
1904	60	74	Machine parts.	Output decreased 10%.
1916	60	818	Machine parts.	Output decreased.

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
—	60	20	Machinery.	Output decreased proportionally.
1915	60	82	Hardware specialties.	Daywork output decreased. Piecework output maintained.
—	60	570	Plumbers' hardware.	Output decreased but not in proportion to the time.
1912	60	720	Architectural steel and bronze.	Output decreased 9%.
1901	60	282	Agricultural implements.	Output decreased 5%.
1902	60	225	Light structural iron.	Decrease in output.
—	60	396	Plumbers' hardware.	Reduction of output.
1917	60	92	Stoves.	Pieceworkers maintained. Dayworkers lost 5% in output.
1906	59	59	Machinery.	Proportional decrease.
1907	59	1,048	Twist drills and reamers.	Proportional decrease.
1901	58½	361	Machine appliances.	Decrease in output about 7% for piecework; about 5% for dayworkers.
1917	58	85	Machinery.	Slight decrease in output.
1917	58	150	Machinery.	Output decreased.
1916	58	2,075	Brass goods.	Output decreased proportionally.
1904	57	96	Machinery.	Output decreased.
1915	57	847	Wire products.	Loss in production.
1912	56	266	Machinery.	Loss in production.
—	56	1,605	Machinery.	Loss in production.
1916	55	1,307	Machinery.	Loss in production.

### REDUCED TO 55 HOURS Production Increased

Establishments . . . . .	3
Employees . . . . .	10,724

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
1915	59	372	Machine parts.	Production increased.
1914	59	10,222	Automobiles.	Daywork not affected; piecework increased 8%.
1915	57½	130	Automobiles.	Increase in total output per employee.

### Production Maintained

Establishments . . . . .	24
Employees . . . . .	8,478

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
1917	61	363	Insulation products.	No piecework. Reduction in hours increased efficiency and, by improving quality, lowered percentage of spoiled work, thus maintaining average of effective production.
1909	60	59	Steam engines.	No noticeable change.
1916	60	76	Hardware.	Practically the same output.

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Date of Change	Previous Hours	Number Employees	Product	Statement of Management
1913	60	1,237	Machine needles.	No effects noticeable.
1912	60	127	Machinery.	No effects perceptible.
1901	60	350	Wire products.	Output maintained.
1902	60	536	Machine parts.	No noticeable change in production.
1911	60	105	Machinery.	No perceptible change.
1916	60	744	Brass and iron castings.	Obtain as great a production in the shorter hours as on former schedule. Also think change has been beneficial to the employees.
1915	59	199	Hardware.	We get just the same results in 55 hours as in 59.
1917	59	264	Machinery.	Output maintained.
1916	59	231	Plated silverware.	Output practically the same.
1916	59	343	Plated silverware.	Production about the same.
1916	59	94	Marine engines.	By judicious arrangement of machines we have observed no decrease in production.
—	59	38	Machinery.	No noticeable effects.
1916	59	775	Machinery.	Output maintained; men keep better time.
1916	59	722	Machinery.	Production maintained.
1917	58	86	Hardware and castings.	Production nearly normal.
1915	58	240	Machinery.	Employees more contented. Output maintained.
1916	58	1,458	Machine parts.	Output maintained. Attendance better.
1909	58	75	Machines.	Output maintained. Machinery speeded up.
1916	57½	230	Machinery.	Apparently no effects.
1917	57½	17	Machinery.	Output maintained.
—	57½	109	Wire goods.	Estimated that change in hours caused no reduction in output.

### Production Decreased

Establishments . . . . .	35
Employees . . . . .	23,670

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
1916	60	683	Iron castings.	Output reduced.
1916	60	446	Silverware.	10% reduction.
1916	60	3,199	Iron and steel castings.	Records show reduced output.
1916	60	1,500	Metal castings.	Decreased 4 to 5%.
1917	60	236	Silverware.	Output decreased proportionally.
1916	60	201	Silverware.	Output decreased.
1914	60	1,800	Shipbuilding.	Proportional decrease.
1908	60	254	Sheet metal.	Production decreased.
1917	60	576	Engines and boilers.	A decrease in output.
1902	60	910	Machinery.	Proportional decrease in output.
1915	60	169	Machinery.	Decreased 8%.
1907	60	96	Electrical machine parts.	Weekly output decreased 7%.



Date of Change	Previous Hours	Number Employees	Product	Statement of Management
1900	59	148	Machinery.	Output decreased.
1913	59	1,018	Machinery.	Less production.
1917	59	95	Machine parts.	Output decreased.
1916	59	1,273	Silverware.	Curtailement of production.
1916	59	200	Silverware.	Output decreased 5%.
1907	59	5,963	Machine tools.	Proportional loss for dayworkers; pieceworkers (90% of the force) eventually maintained.
1915	59	63	Hardware.	Less production.
1905	59	231	Small tools.	Proportional decrease.
1915	59	42	Machinery.	Output decreased.
1913	59	696	Machinery.	Reduction in output less than proportional.
1902	59	913	Machinery.	Reduced output 7%.
1916	59	608	Machine parts.	Output diminished somewhat.
1917	59	697	Machinery.	Reduction in output.
1910	59	44	Machinery.	Less production.
1917	59	219	Machines and castings.	Piecework practically maintained; daywork reduced proportionally.
1916	58	50	Iron and brass castings.	About 10% less.
1910	58	125	Automobiles.	2% decrease.
1907	58	66	Machinery.	Slightly decreased.
1916	58	121	Heating apparatus.	Less than proportional decrease on the whole output.
1914	58	132	Machinery.	Proportional decrease.
1916	58	66	Machinery.	Proportional decrease; no piecework.
1917	57½	360	Hardware.	Output decreased less than proportionally.
1913	57½	470	Machinery.	A decrease in output.

**REDUCED TO 56½ HOURS  
Production Decreased**

Establishments . . . . .	1
Employees . . . . .	231

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
1911	60	231	Machinery.	Proportional decrease.

**REDUCED TO 57 HOURS  
Production Maintained**

Establishments . . . . .	1
Employees . . . . .	100

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
1916	60	100	Iron castings.	Slight decrease in production at first, followed by a slight increase.

**REDUCED TO 58 HOURS  
Production Maintained**

Establishments . . . . .	1
Employees . . . . .	118

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
1916	60	118	Machine accessories.	No important effects.

**REDUCED TO 59 HOURS**

**Production Maintained**

Establishments . . . . . 1  
Employees . . . . . 500

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
1916	60	500	Edged tools.	Output maintained.

**Production Decreased**

Establishments . . . . . 1  
Employees . . . . . 250

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
—	60	250	Machinery.	Output decreased.

## Appendix B

### Results Reported in Replies to the 1919 Questionnaire

#### REDUCED TO 44 HOURS Production Decreased

Establishments . . . . . 7  
Employees . . . . . 3,557

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
*1919	59	191	Machine parts.	Output decreased.
*1919	59	500	Machinery.	Daywork decreased proportionally; piecework nearly maintained.
*1918	55	1,968	Steel boats.	Daywork decreased 20%; piecework decreased 10%.
*1919	55	100	Machinery.	Day and piece work decreased 10%.
*1919	52½	204	Machine tools.	Output decreased in proportion to the decrease in hours.
*1919	52½	56	Machinery.	Proportional loss in weekly output.
*1919	48	538	Automatic machine products.	Proportional decrease.

#### REDUCED TO 44½ HOURS Production Decreased

Establishments . . . . . 2  
Employees . . . . . 2,842

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
*1918	55	2,400	Ships and machinery.	Daywork and piecework decreased.
*1919	52½	442	Machine tools.	Weekly loss in daywork about proportional to reduction in hours; no piecework.

#### REDUCED TO 45 HOURS Production Decreased

Establishments . . . . . 12  
Employees . . . . . 17,378

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
*1919	60	196	Machinery.	Output decreased proportionally.
1918	60	250	Hardware.	Daywork and piecework decreased proportionally.
*1919	55¼	161	Heavy sheet metal.	Weekly output decreased; percentage not known.
*1918	55	111	Engines.	Output decreased for both day and piecework.
*1919	55	220	Fire appliances.	Decreased in same proportion as hours.

\*These establishments changed hours after November 1, 1918.

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
*1919	55	531	Fire appliances.	Daywork decreased in same proportion as hours. Piecework decreased, but less proportionally than hours.
1918	55	1,066	Machinery.	Proportional reduction in daywork. No piecework.
*1919	55	40	Machinery.	Cannot say just what the exact percentage of reduction in production would amount to.
*1919	55	13,274	Manufactured metals.	Output reduction about proportional to decrease in hours.
*1919	54	209	Machinery.	Output decreased 16 $\frac{2}{3}$ %.
*1919	50	721	Machinery.	Daywork and piecework decreased 10%.
*1919	50	599	Machinery.	Daywork decreased 5%. Piecework maintained.

**REDUCED TO 47 HOURS  
Production Decreased**

Establishments . . . . .	1
Employees . . . . .	95

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
*1918	52 $\frac{1}{2}$	95	Machine tools.	Daywork less in proportion; no piecework.

**REDUCED TO 47 $\frac{1}{2}$  HOURS  
Production Increased**

Establishments . . . . .	1
Employees . . . . .	378

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
1917	52 $\frac{1}{2}$	378	Edge tools.	Slight increase in daywork and piecework.

**Production Decreased**

Establishments . . . . .	1
Employees . . . . .	583

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
*1918	52 $\frac{1}{2}$	583	Machine tools.	Estimated decrease of 15% for dayworkers and 5% for pieceworkers.

**REDUCED TO 48 HOURS  
Production Increased**

Establishments . . . . .	1
Employees . . . . .	3,241

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
*1919	52	3,241	Railway appliances.	Output increased 10%.

\*These establishments changed hours after November 1, 1918.

### Production Maintained

Establishments . . . . .	5
Employees . . . . .	2,992

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
*1918	55	1,985	Magnetos.	Output maintained.
1917	54	63	Iron castings.	Output maintained.
*1918	54	169	Machinery.	Daywork maintained; no piecework.
1918	52½	360	Machine tools.	No noticeable effect on output of dayworkers; no piecework.
1918	50	415	Office appliances.	Practically maintained output under shorter schedule.

### Production Decreased

Establishments . . . . .	34
Employees . . . . .	29,363

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
1918	60	1,044	Machinery.	Proportional decrease in output.
1918	60	181	Machinery.	Decrease of 20% in output; no piecework.
*1918	59	42	Machinery.	We consider that our work is proportional to the hours.
1915	56	252	Machinery.	Daywork decreased 25%; no piecework.
*1918	55	1,022	Machinery.	Daywork decreased 20%; piecework 6%.
*1918	55	1,654	Manufactured metals.	Daywork and piecework decreased 12.7%.
*1918	55	6,000	Ships.	Production cut down in strict proportion to reduction in hours.
*1918	55	265	Iron castings.	Output decreased; no piecework.
1918	55	169	Machinery.	Output decreased 20%.
*1919	55	1,621	Machinery.	Decrease proportional to decrease in hours.
*1918	54	433	Plumbers' brass supplies.	Output decreased for both day and piecework.
*1919	54	1,643	Machinery.	Decrease proportional to loss of time.
*1918	54	117	Stoves.	Daywork decreased 10%; piecework decreased 5%.
*1919	54	70	Machinery.	Output decreased 11%; no piecework.
*1919	54	170	Architectural iron.	Output was maintained on part of work but on greater portion it decreased.
*1919	54	160	Iron and metal castings.	Decreased 10%.
*1918	54	79	Light castings.	Output has been reduced but not in same proportion as reduction in hours.
*1919	54	4,825	Railway cars.	No reduction in output was experienced except on machines where the output is governed by the speed of the machine.
1918	54	170	Machinery.	Daywork decreased slightly; no piecework.

\*These establishments changed hours after November 1, 1918.

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
1918	54	172	Hardware.	Daywork decreased 5%; piecework decreased 10%.
*1919	54	487	Stoves.	Daywork and piecework decreased 10%.
1918	53 $\frac{3}{4}$	170	Machinery.	Less output; no piecework.
*1919	52 $\frac{1}{2}$	616	Machinery.	Output reduced; no piecework.
1918	52 $\frac{1}{2}$	826	Machinery.	Output decreased for both day and pieceworkers.
*1919	52 $\frac{1}{2}$	1,400	Machine parts.	Output reduced; better quality of production.
1918	52 $\frac{1}{2}$	544	Power engines.	Proportional decrease.
*1919	52 $\frac{1}{2}$	1,318	Electrical appliances.	Daywork decreased 4%; piecework decreased 2%.
—	52 $\frac{1}{2}$	698	Electrical appliances.	Daywork decreased; piecework maintained. Per cent not known.
*1919	52 $\frac{1}{2}$	1,108	Machinery.	Output has been correspondingly reduced, but we hope to make some of it up at least, by further improving our methods.
1918	51	85	Machinery.	Output correspondingly less; no piecework.
*1919	51	103	Stoves.	Output decreased 10%.
1918	51	800	Machinery.	Curtailed production.
*1918	50	920	Machinery.	Output decreased.
1918	50	199	Electric supplies.	Output decreased.

### REDUCED TO 49 $\frac{1}{2}$ HOURS Production Maintained

Establishments . . . . .	2
Employees . . . . .	615

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
*1919	55	430	Sheet metal products.	Output maintained.
*1918	54 $\frac{1}{2}$	185	Automobiles.	Practically maintained.

### Production Decreased

Establishments . . . . .	3
Employees . . . . .	570

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
*1919	55	210	Small tools.	Daywork decreased 5%; piecework maintained.
1918	52 $\frac{1}{2}$	60	Automatic machine products.	Daywork decreased 6%; no piecework.
1918	52	300	Sheet metal products.	Daywork decreased 5%; piecework maintained.

\*These establishments changed hours after November 1, 1918.

## REDUCED TO 50 HOURS

### Production Increased

Establishments . . . . .	2
Employees . . . . .	1,570

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
1916	59	901	Farm machinery.	Daywork increased 10%. Piecework maintained.
1917	55	669	Automobiles.	Weekly output of day and pieceworkers increased.

### Production Maintained

Establishments . . . . .	10
Employees . . . . .	2,334

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
1918	60	60	Stoves.	Output maintained.
1917	57	19	Machinery.	Output maintained.
*1919	55	40	Machine accessories.	Our output was maintained.
*1919	55	250	Machines and tools.	So far no apparent difference and we hope to maintain our output.
1915	55	386	Machine accessories.	Daywork and piecework maintained.
1918	55	52	Utensils.	Output maintained.
*1919	55	450	Electrical railway supplies.	Getting same production per week; also intensity of application and co-operation from men, which was part of our agreement.
*1919	55	675	Automobiles.	Daywork and piecework maintained.
*1919	55	152	Toys.	Output practically maintained. Several up-to-date machines added.
1913	52½	250	Machinery.	Output maintained.

### Production Decreased

Establishments . . . . .	25
Employees . . . . .	14,650

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
—	60	78	Plumbers' supplies.	Output decreased.
*1919	59	2,406	Agricultural implements.	Output reduced for both day and piecework.
—	59	387	Farm implements.	Daywork reduced 10%. Piecework not reduced.
1918	59	98	Hardware.	Dayworkers accomplish proportionally less; pieceworkers' output remains practically the same.
*1919	59	53	Farm tools.	Output decreased 10%.
*1918	59	22	Farm tools.	Daywork decreased 10%; piecework maintained.
—	55	683	Iron castings.	Output per man has averaged a decrease of approximately 10%.
*1918	55	631	Machines.	Output decreased.
*1919	55	160	Machinery.	Output decreased approximately 10%; no piecework.
*1919	55	300 <sup>a</sup>	Sheet metal products.	Daywork reduced in proportion; output of pieceworkers same.

\*These establishments changed hours after November 1, 1918.

<sup>a</sup> Change applied to press shop only.

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
*1919	55	210	Structural steel.	Daywork decreased 10%; no piecework.
*1919	55	200	Machinery.	Output in our business is practically proportional to hours worked.
*1919	55	5,811	Machinery.	Output slightly decreased.
*1919	55	534	Electrical appliances.	Daywork decreased 10%; piecework maintained.
*1919	55	512	Steel castings.	Output decreased for both day and piecework.
*1919	55	386	Machinery.	Output decreased.
1918	55	116	Machinery.	Decreased 10%; no piecework.
*1919	55	278	Iron castings.	Piecework maintained, daywork decreased.
*1919	55	463	Iron castings.	Output decreased.
1908	55	120	Brass castings.	Output cut down in proportion.
*1918	54	305	Iron castings.	Piecework decreased 4%; daywork decreased 7.4%.
1918	54	462	Valves and hydrants.	Output decreased proportionally.
*1918	54	35	Heavy sheet metal products.	Daywork decreased; no piecework.
1916	54	300	Engines.	Daywork and piecework decreased 9%.
*1918	52½	100	Machinery.	Practically the same hourly production.

**REDUCED TO 51 HOURS  
Production Maintained**

Establishments . . . . .	1
Employees . . . . .	800

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
1918	54	800	Office machines.	No effect on weekly output.

**REDUCED TO 52 HOURS  
Production Decreased**

Establishments . . . . .	2
Employees . . . . .	10,552

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
*1919	55	152	Electric motors.	Output decreased 4¼%.
1915	54	10,400	Electrical apparatus.	Daywork decreased; no effect on piecework.

**REDUCED TO 52½ HOURS  
Production Maintained**

Establishments . . . . .	4
Employees . . . . .	2,217

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
*1919	55	451	Machinery.	Daywork maintained; no piecework.
*1919	55	1,214	Machinery.	Output maintained for daywork. No piecework.
1918	55	15	Electrical appliances.	Weekly output about the same.
1918	54	537	Edge tools.	Weekly output maintained.

\*These establishments changed hours after November 1, 1918.



### REDUCED TO 53 HOURS

#### Production Decreased

Establishments . . . . .	1
Employees . . . . .	32

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
1918	58	32	Castings.	Output decreased.

### REDUCED TO 54 HOURS

#### Production Maintained

Establishments . . . . .	3
Employees . . . . .	2,320

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
*1919	59	660	Farm implements.	Output maintained.
*1918	59	1,400	Farm implements.	Output maintained and general quality of work better.
1918	58	260	Automobiles.	Output maintained.

#### Production Decreased

Establishments . . . . .	6
Employees . . . . .	1,743

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
*1919	60	210	Iron castings.	Output decreased 10%.
*1919	60	85	Light iron castings.	Output decreased proportionally.
1917	59	26	Iron and brass castings.	Decrease in output; no piecework.
1919	58	1,094	Automobiles.	Both day and piece work decreased 7%.
1917	57	105	Heating apparatus.	Daywork decreased proportionally; piecework maintained.
1917	55	223	Sheet metal products.	Amount of tonnage turned out was slightly less.

### REDUCED TO 55 HOURS

#### Production Maintained

Establishments . . . . .	2
Employees . . . . .	159

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
*1919	60	144	Electrical motors.	Output maintained.
1914	60	15	Machines.	Weekly output about the same.

#### Production Decreased

Establishments . . . . .	6
Employees . . . . .	3,505

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
1918	60	15	Plumbers' supplies.	Output reduced just in proportion to reduction in hours.
1918	59	289	Iron castings.	Output decreased proportionally in the machine shop. Maintained in the foundry.
*1919	59	332	Agricultural implements.	Output decreased, but not in proportion to decrease in working hours.

\*These establishments changed hours after November 1, 1918.

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
—	59	55	Machine tools.	Daywork decreased 7%; piecework maintained.
*1919	59	200	Machine tools.	Output decreased proportionally.
*1918	57½	2,614	Railway cars.	Our production has decreased, partly because of the shorter day.

**REDUCED TO 57½ HOURS  
Production Maintained**

Establishments	1
Employees	65

Date of Change	Previous Hours	Number Employees	Product	Statement of Management
*1919	60	65	Iron and steel wire.	Former schedule too long a period without rest, resulting in greatly decreased efficiency. Weekly output maintained under shorter schedule.

\*These establishments changed hours after November 1, 1918.





# Publications of the National Industrial Conference Board

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- Research Report No. 1.* WORKMEN'S COMPENSATION ACTS IN THE UNITED STATES — THE LEGAL PHASE. April, 1917. Revised April, 1919.
- Research Report No. 2.* ANALYSIS OF BRITISH WARTIME REPORTS ON HOURS OF WORK AS RELATED TO OUTPUT AND FATIGUE. November, 1917.
- Research Report No. 3.* STRIKES IN AMERICAN INDUSTRY IN WARTIME. March, 1918.
- Research Report No. 4.* HOURS OF WORK AS RELATED TO OUTPUT AND HEALTH OF WORKERS — COTTON MANUFACTURING. March, 1918.
- Research Report No. 5.* THE CANADIAN INDUSTRIAL DISPUTES INVESTIGATION ACT. April, 1918.
- Research Report No. 6.* SICKNESS INSURANCE OR SICKNESS PREVENTION? May, 1918.
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- Research Report No. 8.* WARTIME EMPLOYMENT OF WOMEN IN THE METAL TRADES. July, 1918.
- Research Report No. 9.* WARTIME CHANGES IN THE COST OF LIVING — JULY, 1914, TO JUNE, 1918. August, 1918.
- Research Report No. 10.* ARBITRATION AND WAGE-FIXING IN AUSTRALIA. October, 1918.
- Research Report No. 11.* THE EIGHT-HOUR DAY DEFINED. December, 1918.
- Research Report No. 12.* HOURS OF WORK AS RELATED TO OUTPUT AND HEALTH OF WORKERS — WOOL MANUFACTURING. December, 1918.
- Research Report No. 13.* REST PERIODS FOR INDUSTRIAL WORKERS. January, 1919.
- Research Report No. 14.* WARTIME CHANGES IN THE COST OF LIVING — JULY, 1914, TO NOVEMBER, 1918. February, 1919.
- Research Report No. 15.* PROBLEMS OF INDUSTRIAL READJUSTMENT IN THE UNITED STATES. February, 1919.
- Research Report No. 16.* HOURS OF WORK AS RELATED TO OUTPUT AND HEALTH OF WORKERS — SILK MANUFACTURING. March, 1919.
- Research Report No. 17.* WARTIME CHANGES IN THE COST OF LIVING—JULY, 1914, TO MARCH, 1919. May, 1919.
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